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DEPARTMENT OF THE ARMY FIELD MANUAL

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SIGNAL COMMUNICATIONS DOCTRINE

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DEPARTMENT OF THE ARMY • JULY 1948

ERRATA

Wherever the term "Military Command and Administrative Network (MCAN)" is used, it should be corrected to read "Army Command and Administrative Network (ACAN)."

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SIGNAL
COMMUNICATIONS
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CONTENTS

Paragraph Page

SECTION I. COMMAND FUNCTIONS OF COMMUNICATIONS.

Relation of command and signal communications	1	1
Staff relations of signal officers	2	3
Communications within the unit ...	3	4
Signal communications to adjacent and supported units	4	7
Location and movement of command posts	5	9
Security of signal communications..	6	11
Circuit allocation	7	15
Communication centers	8	17
Signal supply	9	19
Signal communications training ...	10	21
Signal communications personnel...	11	23
Signal communications planning ...	12	24
Other responsibilities of commanders	13	24

II. MEANS OF SIGNAL COMMUNICATION.

Radar	14	25
Messengers	15	25
Electrical means	16	27
Wire and cable	17	27
Radio	18	31
Telephone	19	36
Teletypewriter	20	41

	<i>Paragraph</i>	<i>Page</i>
Manual telegraphy	21	44
Facsimile	22	45
Pigeons	23	46
Visual and sound communication ...	24	46
Principles of use	25	47
 III. DEPARTMENT OF THE ARMY SIGNAL COMMUNICATIONS.		
Responsibilities of the Chief Signal Officer	26	50
Military Command and Administrative Network (MCAN).....	27	51
Major commands, theaters, etc.	28	53
Signal supply	29	56
Signal communications training ...	30	61
Signal communications personnel ...	31	63
Signal communications planning ...	32	64
 IV. THEATRE SIGNAL COMMUNICATIONS.		
General	33	66
Theater signal communications service	34	66
Radio communications	35	72
Signal communications security ...	36	73
Signal supply	37	74
Signal communications personnel ..	38	75
Signal communications planning ...	39	77
Miscellaneous	40	79
 V. ARMY COMBAT FORCES SIGNAL COMMUNICATIONS.		
General	41	81
Signal communication for command and administration	42	83
Communications for fire and movement control	43	84

	<i>Paragraph</i>	<i>Page</i>
Communications for support	44	85
Unit signal or communications officers	45	86
Signal supply	46	88
Signal instructions and orders	47	89
Signal communications training	48	91
Signal communications planning ..	49	92
Staff coordination and cooperation..	50	93
INDEX		95

SECTION I

COMMAND FUNCTIONS OF COMMUNICATIONS

1. RELATION OF COMMAND AND SIGNAL COMMUNICATIONS. a. In modern warfare, no commander can exercise command of more than a handful of men by his physical presence. To receive information upon which to base his decisions, to transmit his commands, to secure the supplies and munitions for carrying out his plans, he must rely upon signal communications. In this day of dispersion of enormous forces, rapid signal communications are virtually synonymous with electrical communications. A commander who is out of communication with a subordinate unit has lost control of that unit until he reestablishes electrical communication with it, unless the unit is acting under mission orders giving it the necessary freedom of action and initiative to act in accordance with the commander's plan and as the situation may dictate. It follows that signal communications are vital to the exercise of command and that each commander must feel deeply responsible for the successful operation of his signal communications.

b. To assist him in his command functions pertaining to signal communications, the commander is furnished a signal officer who advises the com-

mander in technical matters, and who is responsible to the commander for installation, operation, and maintenance of the signal communications system. The fact that signal communications frequently present very technical problems does not permit a commander to divest himself of responsibility for the success or failure of the system. While he must rely upon his signal officer for technical advice and for the planning and execution of the technical details of signal communications, the commander should know the capabilities and limitations of his signal communications equipment as well as he does the characteristics of his weapons. The commander should seek the advice of his signal officer in regard to any contemplated plan of action so that he will be aware of the personnel, material, and the time required to provide signal communications support.

c. It is the purpose of this section to set forth the major specific responsibilities of a commander with respect to signal communications and to indicate how, with the assistance of his signal officer, these responsibilities should be met. In effect, this section states the relations which should exist between the commander and his signal officer and between the signal officer and other members of the commander's staff. The doctrine is applicable in principle to all echelons of command and differs at each echelon only because of the differences in scope of the command exercised by the echelon.

2. STAFF RELATIONS OF SIGNAL OFFICERS. a. The duties and the responsibilities of the signal officer affect every member of the general staff; G-1 on personnel, G-2 on intelligence and signal communications security, G-3 on operations and counter measures, and G-4 on supply and signal communications for administrative purposes. The signal officer, therefore, operates in the same manner as other special staff officers, coordinating with the general staff section concerned, and reporting to the chief of staff on matters not requiring coordination or on which agreement cannot be reached. The signal officer should be included in any planning section or committee in order that he may present the communications aspect of any operation under consideration.

b. The relations of the signal officer with corresponding staff officers of higher and lower echelons of command are difficult to define exactly. He deals with them directly on technical matters. However, "technical matters" often involve many of the attributes of command and the signal officer must know how far he can speak in the name of his commander in dealing with higher and lower echelons of command. The commander must make clear to his signal officer and to all others concerned exactly what authority he delegates to him in accomplishing the task of supervision and coordination of signal communications, and on what matters the chief of staff or the commander must be consulted prior to making commitments.

3. COMMUNICATIONS WITHIN THE UNIT.

Each commander is responsible for signal communications within his unit (see par. 34 for the exceptions that are made when the unit is being served by the Theater Signal Communications Service). With the signal troops which are assigned to his headquarters, he constructs, maintains, and operates signal communications to the command post of each next subordinate unit of his command. When subordinate headquarters operate a command post in two or more echelons, he may construct, maintain, and operate signal communications to all echelons, or he may have direct signal communications with only the forward echelon and reach the other echelons of the subordinate command post over the signal communications facilities of the subordinate unit. Frequently it may be practicable and convenient to secure communications with the rear echelons of larger headquarters by connection through the theater signal communications system (see par. 34).

a. To obtain signal communications to the command posts of his subordinate units, the commander relies upon his signal officer for planning and execution. The signal officer must always be fully apprised of the plans of the commander and, therefore, should have ready access to the commander and his chief of staff. In considering plans for any operation, the commander usually, through the chief of staff or operations officer, consults the signal officer to learn what signal communications support can be given each plan proposed and weighs the adequacy of signal communications support for

each plan just as he weighs the possible ammunition supply or any other factor affecting the plan. If a plan cannot be supported by sufficiently reliable signal communications to give the degree of control required for the success of the plan, serious consideration should be given to the alteration or abandonment of the plan.

b. In order to execute the signal communications plan, the signal officer commands for operations in the name of his commander all signal communications troops assigned or attached to the headquarters. The essentials of his command function are command for training, command for tactical employment, and the monitoring of the administrative and supply functioning of his signal communications units to the extent necessary to insure the operational success of his commander. To assist him in this exercise of command, and to free him as much as possible of burdensome detail, the signal officer utilizes members of his own staff and members of the commander's staff. For example, movement orders are issued at the signal officer's request by the commander's adjutant general, and the review of court-martial proceedings is done by the commander's judge advocate. In matters of training and operations, the signal officer deals directly with his units as the occasion requires. The commander holds him generally responsible for the proper administrative and supply functioning of the signal communications units. In those headquarters having several signal communications units attached or assigned, it will be normal to group these under the administrative command of

a headquarters set up for the purpose and responsible to the signal officer.

c. The commander is also responsible for signal communications within each of his subordinate units. He discharges this responsibility generally through staff supervision and inspection by his signal officer (and the latter's assistants) and by orders, memoranda, annexes, etc. Although the commander of each unit is responsible for signal communications within that unit, and normally has under his own command the means to establish signal communications to serve the unit, the signal communications which he establishes must form an integral part of the overall signal communications system. Therefore, each commander is responsible that the signal communications of his subordinate units and those of his own unit combine to form an integrated system. He is also responsible to his superior that all of his signal communications, whether of his own unit or his subordinate units, fit into the overall signal communications system of his superior. In his own signal communications plan, a commander may require certain signal communications facilities which may be provided more advantageously or economically by one or more subordinate units of his command. In such case he may require the subordinate unit to furnish such facilities for use by the higher headquarters system. For example, an army headquarters requiring direct telephone and teletype channels to its divisions for purposes of administration and supply may direct its corps headquarters to furnish those parts of the circuits which lie between the corps

command post and the division command posts. When a subordinate unit is required to furnish facilities for a higher headquarters, assistance should be given by the higher headquarters to the subordinate unit, if necessary, either in the form of additional personnel or equipment or by performing some part of the subordinate unit's tasks of construction, maintenance, or operation, or both.

d. In the discharge of his responsibilities for signal communications in his subordinate units, the commander expects his signal officer to effect coordination by dealing directly with the signal officers of subordinate units on routine technical matters and to make suitable recommendations for issue of command directives in matters that do not fall within the routine technical classifications.

4. SIGNAL COMMUNICATIONS TO ADJACENT AND SUPPORTED UNITS.

a. The general principle of signal communications in the case of supporting and supported units is that signal communications are furnished by the supporting unit to the unit supported. When the exigencies of the situation demand a variation in the application of this doctrine, the common commander of both supported and supporting units has the responsibility for decision as to what variation should be made. In formulating a decision to vary this principle, he considers the relative means available to the supported and supporting units and obtains the recommendations of his signal officer before reaching a decision.

b. Lateral communications, namely, signal communications between adjacent units at the same echelon of command, are established as directed by the higher commander. Generally, the highest independent commander engaged in an operation will prescribe whether lateral signal communications between adjacent units will be from right to left or left to right. In carrying out this decision, commanders will determine the manner of execution by their subordinate units. A commander may prescribe that his subordinate units provide direct circuits to the units with which they are required to have lateral signal communications or may decide that adequate lateral communication is available by switching through his own headquarters. He may also elect to provide from facilities connecting his command post to the subordinate command posts, circuits which will give direct electrical communications between the two subordinate headquarters. In deciding which method of providing lateral signal communications is to be used, the commander weighs his own means and the means available to his subordinate commanders. In the case of lateral signal communications between units which are not immediately subordinate to the same commander, decision as to the method of lateral signal communications to be employed is made by the first common higher commander. Lateral communications between the headquarters of larger units may often be effected most economically and adequately by the connection of such units into the theater signal communications system. (See par. 34.)

5. LOCATION AND MOVEMENT OF COMMAND POSTS. a. The proper location of the command post plays a most important part in the success of signal communications. Generally when the command post is located at an existing or potential center of signal communications facilities, the other requisites of a command post will be found there also. The mere proximity of a place to the spot where most of the action is occurring or is expected to occur, does not make it necessarily the best spot from which to exercise command. The location of the command post at the natural heart of the signal communications system will give the commander the best opportunity to exercise command effectively. The commander therefore considers the location of his command post primarily from the viewpoint of signal communications and should require the signal officer to advise him as to the most suitable location or locations. At the same time, the commander also considers what should be the location of the command posts of his subordinate units so as best to fit into the integrated signal communications system and yet not deprive the subordinate commanders of opportunity to exercise command effectively. Each commander advises his subordinate commanders of the locations he considers most suitable for their command posts and subordinate commanders should not place their command posts at any considerable distance from the locations so designated without obtaining prior approval of the higher commander.

b. It is the responsibility of the higher commander to establish and maintain communication

from his own command post to those of his subordinate units. In fast moving situations it is difficult to maintain signal communications with subordinate units, and, whenever possible, the higher headquarters should be given advance notice of intentions to move. A subordinate commander must not, in any event, rupture signal communications with his higher commander. When a subordinate commander must move his command post without prior notice to his higher commander it is his responsibility to see that communication is not broken and that his new location is promptly reported.

c. As the action moves forward or backward it becomes desirable to relocate the command post. The number of such moves should be held to a minimum. Each movement of the command post, even when skillfully accomplished, causes a temporary reduction in staff efficiency and in the effectiveness of control of subordinate units. Frequent movements of the command post also exhaust signal communications personnel and thereby lower the efficiency of the signal communications system by which command is exercised. Therefore, the commander must weigh carefully the advantages and disadvantages before deciding to move his command post. Before making his decision, he should seek the recommendations of his signal officer in the matter.

d. In amphibious or airborne operations the movement of a task force and subordinate units must be treated in the same manner as a movement of the same units on land. Signal communications

must remain uninterrupted (except for such temporary security measures as are employed). The command posts of all echelons in amphibious operations are located initially aboard ship where required communications facilities are normally furnished by the U. S. Navy supplemented, if necessary, by Army equipment and manned by organic U. S. Army personnel. For the movement to and the establishment of each command post ashore, organic communications equipment and personnel are used to maintain continuous signal communications. When necessary for a headquarters to operate in echelons, one echelon remaining aboard ship and another established ashore, communications will be as in normal land operations.

e. In the planning of signal communications systems, it is usually insufficient to designate merely the next command post site to be occupied. Normally, commanders will designate a succession of planned command post sites numbering at least two and preferably three in order to give continuity to both planning and execution. Such future tentative locations for command posts should be announced in field orders for the operation.

6. SECURITY OF SIGNAL COMMUNICATIONS. a. Every commander has the responsibility for signal communications security in his unit. Signal communications security is accomplished by procedures which safeguard against the physical compromise of classified material, by cryptographing classified messages whenever there is possibility that the enemy may intercept them, and by

adherence to approved electrical transmission procedures. The commander is responsible for the execution of all procedures prescribed by higher headquarters to give security to his signal communications and to safeguard against compromise those cryptographic systems which are used in his communications. He discharges his responsibility for security within his signal communications system through his signal officer who carries out all details of compliance.

b. Maximum communications security is obtained by employing every safeguard prescribed by higher headquarters. However, in many operations there are times when the employment of these safeguards may so impede rapid signal communications as to jeopardize the success of the mission. In such cases, the commander must consider whether, in order to achieve less delay, a relaxation of signal communications security as pertains to the encrypting of messages will facilitate the accomplishment of his mission more than the information offered to the enemy could prevent it. Much that is of *apparent* contemporary interest is valueless to the enemy by itself and he cannot use the information obtained from one such piece of information to thwart the immediate plan of the commander. However, many such items of information, each without value intrinsically, can be combined to ascertain the future plans of the commander or perhaps the plan of a higher commander.

c. The commander has, therefore, a conflicting responsibility in that he must provide entirely adequate signal communications by the full and free use of which he can best exercise command, and at the same time see that his signal communications are so used that the enemy does not obtain damaging information of his plans or those of a higher commander. If the commander unduly emphasizes maintenance of security of his signal communications, he will risk the success of his mission because he himself, his staff, and his subordinate commanders are hampered in the performance of their duties by the delays imposed upon rapid signal communications by the safeguards necessary to security. If, on the other hand, he fails to observe sufficient of the rules of signal communications security to keep the essentials of his plans from the enemy, his mission may fail because the enemy, forewarned, can take action to defeat the execution of his plans. The commander, therefore, bears a heavy responsibility for the security of messages and information passed over the signal communications system.

d. There is no hard and fast rule by which the degree of security of signal communications desirable in a given situation can be stated. Generally, in a static situation, the enemy will have available more and better means for attacking the security of our signal communications, and at that time all safeguards to security must be employed. Similarly, in a static situation, the information to be gained from day to day by a breakdown of security will permit the enemy better to estimate the plans

of the commander. Generally also, in a rapid pursuit, signal communications facilities are meager and must be used to the fullest capability, but the enemy is at the same time less able to take advantage of lapses of security. A considerably greater freedom from the restrictions desirable for maximum security is indicated in such a situation. Full use of the signal communications facilities at his disposal will permit the best control and supply of his troops, whereas disregard of security measures in whole or in part may cause the failure of his mission. Since the commander is responsible for accomplishment of his mission, he must make the decision as to how far, if at all, he will disregard and allow to be disregarded the measures which will give maximum security to his signal communications. If he takes a risk by electing to relax signal communications security, the risk must be calculated.

e. To assess the risk, he must be familiar with the capabilities of the enemy in attacking his signal communications and with the limitations as to security of his various means of signal communications. Therefore, when making his plans, he will consult his signal officer as to the effect which various security measures will have upon his signal communications during the execution of his plan, and the limitations of his signal communications equipment from the viewpoint of security. He will at the same time consult G-2 as to the capabilities of the enemy in attacking the traffic carried in his signal communications and as to the effect which enemy success resulting from relaxation of signal

communications security might have upon the success of his plan. He will then evaluate all these recommendations and make his decision as to the degree of relaxation of signal communications security, if any, he will authorize in connection with the completion and execution of his plan.

f. The above applies to a general relaxation of signal communications security such as authorizing transmission of secret material in clear over teletype wire lines or directional radio-teletype links within a selected area, and not to the transmission of a single message in clear; the latter case is thoroughly covered by existing regulations. *In no case will the relaxation of signal communications security prescribed by a commander allow the compromise in any way of the plans of a higher commander or of a cryptographic system held by anyone outside his immediate command.*

7. CIRCUIT ALLOCATION. a. It is the responsibility of each commander that the communications system within his unit, whether established by troops under his immediate control or by troops assigned to subordinate headquarters, shall form a single integrated signal communications system. Each commander, therefore, exercises the function of circuit allocation. Circuits are used on a "common user" basis, that is, they are generally available to all in the headquarters in accordance with priorities established by the commander. (See also sec. IV.) When signal communications facilities are very meager, it may be necessary for more

than one headquarters or service to use circuits on the "common user" basis, but generally circuits will be allocated for direct communications needs between two headquarters when either of the requirements of (1) or (2) below are met. There also occasionally exists need for direct circuits between certain individuals or activities. The necessity for direct circuits is established by either of the following:

(1) Requirement for speed of signal communications which prohibits the delays incident to the switching of "common user" facilities. Examples of such requirements are all types of operational and control circuits such as Air Force and bomber command control circuits, aircraft warning and fighter control circuits, artillery and guided missiles, fire control circuits and the like.

(2) Sufficient traffic volume between the headquarters activities (or in occasional instances, individuals) to warrant direct connection instead of "common user" facilities; a traffic volume requiring total use during 6 hours out of the 24-hour day is considered justification for allocation of direct signal communications facilities.

b. The demand for circuits allocated directly between headquarters, individuals, and activities will always exceed the supply and it is the responsibility of the commander, assisted by his signal officer, to decide what, if any, circuits can be allocated in a given situation. When insufficient facilities are available, the preference will normally be given to allocating direct circuits described in a(1)

above before allocating those described in a(2) above.

c. There exists also in the area covered by most commands certain activities and organizations which require trunk signal communications service but do not have the means to provide such service. Examples are air support control, signal intelligence, and artillery command circuits which, because of troops and equipment available and distances involved, cannot provide satisfactory trunk circuits for their normal operations. In such cases, the higher commander having interest in the activity requiring the trunk signal communications will, if practicable, allocate the necessary circuits from circuits directly or indirectly under his control. If the paucity of facilities does not permit allocation of direct circuits, he will assure himself that the activity is provided an equitable share of available "common user" facilities.

8. COMMUNICATION CENTERS. a. The communication center is responsible for the receipt of or dispatch of all messages which are not handled "person to person" by telephone or teletype and which are not communications handled by the Army Postal Service. The communication center receives messages from within its own headquarters and dispatches them with minimum practicable delay. It delivers the action copy of messages incoming to the headquarters to the staff officer designated by the commander to receive such messages. The communication center does not duplicate incoming messages nor distribute information

copies thereof within the headquarters. The communication center consists of those means of signal communication by which messages are received and transmitted, cryptographic facilities and personnel, and a message center which regulates the movement of messages within the communication center and effects delivery within the headquarters. The communication center is responsible for the dispatch of messages by that means of signal communication which will insure the most expeditious and economical arrival in the hands of the action addressee. The decision as to the most efficacious means is normally made in the communication center and not by the originator of the message. The efficiency of the communication center and its speed in handling messages is dependent upon the close proximity of the communication center to all sections of the headquarters served. The communication center in performing its mission does not become an office of record.

b. The internal efficiency of the communication center is a technical and administrative matter for which the commander holds his signal officer directly responsible. The overall efficiency of the communication center is improved by the commander's insistence on compliance with the following:

- (1) The communication center must be furnished a list of the signatures of those officers authorized to authenticate messages.

- (2) All messages must be properly prepared with respect to classification and precedence. All officers

must be thoroughly trained in the preparation of messages.

(3) When, in the absence of an adequate postal service, the communication center is required to deliver those official communications normally handled by the postal service, the delivery responsibility of the communication center will be limited to those headquarters and installations normally served. The dispatches for each headquarters will be placed in a pouch by some designated staff section and delivered to the communication center where only a pouch receipt will be issued. No check of contents will be made.

9. SIGNAL SUPPLY. a. The diversity and complexity of signal communications equipment render its supply difficult. Successful signal communications depend upon adequate and prompt supply. Each commander is, therefore, vitally concerned that his signal supply be closely linked to his signal communications operations. To secure this coordination, he holds his signal officer responsible for the efficiency of the signal supply system within his command.

b. Although impetus of supply is from rear to front, efficient supply operation is not necessarily obtained by pushing to the front large quantities of equipment and supplies in excess of current needs. Supplies are furnished most efficiently to the users when a proper stock control system maintains knowledge of the exact location of supplies, when the supplies are centrally located for rapid movement to the users, when the shipment of sup-

plies is made promptly to the users, and when such shipments are followed through to their destination. This should not preclude, at the discretion of the theater commander when the operational situation requires, the establishment at various levels of command of pools of that equipment and those supplies having a considerable usage factor in the unit in order to permit the immediate replenishment of unit losses. Excepted from such pools are items which, because of maladjustment in production or distribution channels, are in short supply; these items are termed "critical items" and their issue is controlled directly by the highest headquarters affected by the short supply.

c. It is recognized that each T/O&E represents the best estimate of requirements, based on experience, but that it is only an *average* requirement of all units. It is, therefore, necessary in many situations to withdraw some equipment furnished by T/O&E, to supplement the T/O&E with other equipment, or to do both. The prerogative of making such additions and deletions to T/O&E is delegated by the Department of the Army to the theater commanders who are furnished by the Department with a pool of equipment and correlated supplies from which additions to T/O&E may be made. This pool of equipment is in addition to the pools described in the preceding paragraph, as the former are constituted from equipment and supplies furnished normally through supply channels for replacement and replenishment purposes. The Department of the Army will also establish in each theater a pool of project type

signal communications equipment, based upon the potential needs of the theater and constituting an advance shipment against operational projects of the theater in process of submission to the Department of the Army.

d. In order to insure coordination of signal supply and signal communications operations, each commander vests in his signal officer direct operating control of all signal depots, signal sections of general depots, or signal dumps under his command.

e. Although fourth and fifth echelon maintenance of signal communications equipment are properly the responsibility of shops established in depots, other maintenance is pushed as far forward as possible by mobile maintenance teams reasonably equipped with tools and parts for repair. These mobile teams supplement organizational maintenance.

10. SIGNAL COMMUNICATIONS TRAINING.

a. The training of signal communications personnel is made difficult by the number of different specialties required and the high degree of training and intelligence demanded in many of these specialties. There are many categories of signal communications personnel which must be selected for proper AGCT score and trained in schools; this is because only few of a given type of specialists are required in each unit, the equipment needed to train them is special and expensive, and a high degree of technical proficiency is demanded on the part of instructors. The requirement that the signal

communications system should constitute technically one integrated whole calls for a high degree of standardization. Therefore, when the same type of specialists is trained in more than one school, the Department of the Army will standardize instruction and the qualification requirements for graduation.

b. Standardization, ease of training, and command supervision are best achieved when the specialist training of those specialists who are not school trained is conducted under one head. Commanders will require their signal officer to supervise closely or direct the training of signal communications specialists and of signal or communications units under their control. Normally this will include the selection, under approved policies, of those specialists who are to be school trained.

c. Training is continuous. Initial training of signal communications specialists is aimed at producing personnel with a sufficient degree of proficiency to begin team training. However, when team and unit training have progressed sufficiently, personnel who have been trained in a single specialty should be rotated with others so that each may acquire proficiency in specialties related to his basic specialty.

d. A serious difficulty in training is encountered because of the "perishability" of many signal communications specialists. During the long periods spent in transfer to oversea theaters, many such specialists lose much of their recently acquired training and skill unless steps are taken to keep them constantly refreshed. Consequently, refresher

training is continuous in the replacement stream. Replacements must receive refresher training while awaiting port calls, while on shipboard, and when awaiting forward movement in replacement depots. In theaters, the theater signal school or a branch thereof, will be located adjacent to the replacement depot in order to provide this refresher training. The theater signal school has also missions of training personnel already in the theater in newly introduced equipment and of retraining combat casualties for non-combat duties.

11. SIGNAL COMMUNICATIONS PERSONNEL.

a. The number of specialties and the long-term training required in signal communications demand that special care be used in the assignment of signal communications personnel. It is unlikely that sufficiently highly trained signal communications personnel will ever be available, and every care must be taken by each commander to see that personnel available are properly assigned to accomplish his overall mission. The commander will require his signal officer to review the classification and assignment of all signal communications personnel under his control and to recommend any necessary changes.

b. The signal officer will also furnish staff assistance to G-1 to effect supervision over promotions, demotions, requisitions, and distribution among units, of signal personnel within the unit.

12. SIGNAL COMMUNICATIONS PLANNING.

The success of signal communications depends upon timely and adequate planning. Since command pervades every part of the operation of a unit and is served by signal communications, it follows that the signal officer must be apprised of every element of future planning concerning the command. Planning is continuous and plans must be constantly revised to meet the changing situation. Commanders must, from the earliest inception of a plan or change of plans, acquaint their signal officers with the necessary details and require their comments as to support of the plan or changes which may be necessary in order to give the plan adequate signal communications support.

13. OTHER RESPONSIBILITIES OF COMMANDERS. Commanders have other responsibilities pertaining to signal communications not all of which are common to all agencies. Some of these are signal security, radar, the assignment of frequencies and call signs for radio sets, and photography. A more complete statement of these responsibilities is found elsewhere in this manual under the duties of the signal officer. Wherever such duties under the signal officer are stated, they are also responsibilities of the commander and the authority of the signal officer is that derived from delegation to him by the commander.

SECTION II

MEANS OF SIGNAL COMMUNICATION

14. RADAR. Radar is a radio device which may be used to locate or identify objects such as aircraft or ships even though they may be invisible because of darkness, fog, or distance. It is, therefore, a device for obtaining intelligence by electrical means and is sometimes considered a means of communication. However, for the purpose of this manual, it is not considered as such.

15. MESSENGERS. a. The oldest method of transmitting messages is by messenger or runner. The use of messengers will continue to be a primary means of communication both within and without the headquarters to which messengers are assigned. They must always be used in the transmission of bulky material and they should be used, also, when time of delivery will be less than that required for encrypting and decrypting if electrical means of communication were used. The training of messengers and runners is of the utmost importance.

b. There are three types of messengers employed at a message center: local messengers who distribute incoming messages locally within the command post, scheduled messengers, and special

messengers. The latter two types may travel by either air or motor vehicle. Such aircraft and motor vehicles as are provided must be under the full control of the communication center. Within the army area in the combat zone the required airplanes are furnished by units organic to the army or lower headquarters. For the airplane messenger service serving the theater headquarters and other installations of the communication zone, airplanes are furnished by the air units designated by the theater commander. In this area scheduled flights will be arranged to meet normal requirements. Scheduled messengers are employed on a fixed schedule to circulate between a command and its subordinate units. The senior headquarters is responsible for establishing scheduled messenger service to subordinate units. Special messengers are employed whenever required by the urgency of the message. The schedule for scheduled messengers to subordinate units and from superior units should be circulated to all staff officers and all units concerned and kept readily available in all offices in order that these messengers may be used to the fullest extent and that special messengers may be used sparingly.

(1) In the combat zone it is customary and almost mandatory to furnish a vehicle driver with the vehicle employed by the messenger.

(2) Where the adjutant general employs the communication center messenger service, he will use special pouches for the transmission of routine papers, pamphlets, manuals, etc., between major commands. (See par. 8b(3).)

16. ELECTRICAL MEANS. The two basic electrical means of signal communication are wire and radio. Either or a combination can be used to transmit telegraph, teletype, telephone or facsimile. There are fundamental differences between wire and radio communication as well as in the manner in which messages are transmitted by each which are described briefly in succeeding paragraphs.

17. WIRE AND CABLE. a. Generally, wire communication takes longer to install than does radio communication. Once installed, it is at present capable of greater flexibility in its use and of carrying a greater volume of traffic for a given number of personnel than is radio. It has a great advantage over radio communication in that messages transmitted over wire alone cannot be intercepted by the enemy unless the enemy electrically connects apparatus to the wires carrying the messages. Wire is, therefore, at the present time the more secure of the electrical means of signal communication.

b. Wire communication is more susceptible to interruption by friendly troops than is radio. Normally, it is necessary to construct the wire lines along roads or railroads in order to economize on construction time and labor and to minimize later maintenance. Such wire lines are immediately and constantly exposed to hazards from enemy action, passing traffic, engineer road construction and maintenance crews, and even from friendly troops practicing marksmanship with insulators as targets. Undisciplined troops and civilians have often cut out sections of wire circuits for personal use or as

sabotage. The maintenance of wire circuits is greatly lessened and the dependability of signal communication over them is greatly increased when the command understands the importance of safeguarding them. Troops of all units should be properly instructed as to the importance of wire circuits and in the necessity for avoiding damage to such circuits. Appropriate disciplinary measures should be taken in instances of wanton or careless acts which damage wire lines.

c. There are several types of wire in use at present, each of which may be expected to change with the progress of the art.

(1) Assault wire, or any substitute therefor, is a light pair of wires, twisted together, having low tensile strength and a very limited range of dependable communication. It is made light so that it can be carried and laid by men and so that a considerable quantity can be carried by a single man. To secure such lightness there must be sacrificed a good deal of the desirable tensile strength which would make it last longer when under strain. The insulation is also less tough and since this wire is habitually laid on the ground, it is often damaged by traffic or cut by missiles, etc. Conductivity has also been sacrificed for portability so that the assault wire is suitable for signal communication over short distances only. This wire is developed solely for the use of front line troops and should not be used elsewhere. When several miles of assault wire are connected to a standard telephone system, the success of a long distance call will be largely determined by whether or not it is possible

to talk clearly over the assault wire section of the circuit.

(2) Field wire is similar to assault wire except that it is designed for use where the element of portability is not paramount. Field wire is generally laid from vehicles, is placed on poles or trees whenever practicable, and is intended to have a longer life than assault wire. Consequently, it is heavier than assault wire, stronger, better insulated, and has a greater dependable range of signal communication. The range of dependable signal communication is still only of the order of 10 to 12 miles and field wire use is, therefore, limited in application. It is used for connection of telephones or teletypes to switchboards and for trunk circuits which are not longer than 10 or 12 miles. It is less vulnerable than assault wire but should be placed overhead whenever possible. The range of field wire can be increased by the use of electrical repeaters at intermediate points in a long line, or by use of amplifying telephones at the terminals.

(3) Spiral four is a four-wire cable designed for fairly rapid construction and especially to permit the use of carrier and repeaters. By the use of carrier equipment, the four wires will yield four telephone channels, each of which may be subdivided into four teletype or telegraph channels. The use of repeater equipment at the proper intermediate points on the cable allows the range of dependable signal communication to be extended to at least a hundred miles. This cable is vulnerable to traffic and other hazards, and should not be laid

on the ground if the situation will permit placing it overhead or underground.

(4) Open wire consists of solid uninsulated wires placed on poles. The wire may be copper, steel, or copperclad steel. It is normal to construct army open wire circuits so that carrier and repeater equipment can be used on trunk circuits. At the present time, each pair of wires so constructed will, with the use of properly placed carrier and repeater equipment, yield four to six telephone channels, each of which is divisible into four or more teletype or telegraph channels. Open wire circuits take a relatively long time to construct. A well trained signal construction battalion, very ably led and well supplied, can construct as much as 30 miles of eight-wire pole line per week. Once constructed, open wire is very suitable as the backbone of the long distance communication system and with good maintenance and discipline, it is very dependable over long ranges.

d. Cable is a number of insulated wires bundled together within a protective sheath. Cables may be placed overhead or underground. The proper type of cable can be used with carrier and repeater equipment just as is open wire except that the repeater spacing is less. The cable has the advantage of allowing a large number of circuits to be constructed with more speed than if the same number of open wire circuits were built. It has the disadvantage of "placing all the eggs in one basket" so that when the cable is damaged, a great many circuits may be lost at the same time. Cable employing carrier and repeater equipment is very suitable for

use as the backbone of the long distance signal communications system. Cable is also used in local installations whenever available and when a number of circuits follow the same route. This type of cable is not made for carrier and repeater use.

e. Coaxial cable is not presently used in the Army but may be expected as a development. It has the advantages that many signal communication channels can be derived from two conductors and that it can be employed with suitable auxiliary equipment to transmit television. It has the disadvantage that damage to it paralyzes all the circuits derived from the cable. It appears to be eminently suited to be the backbone of the long distance signal communications system.

18. RADIO. a. The great advantage of radio communication is that no construction is required in the space between two radio stations. Because of this characteristic, radio communication can usually be installed much more quickly than can wire communication. If the sets remain installed, as they do in the mobile radio sets of airplanes, ships, and certain vehicles, radio communication can be continued even while the sets themselves are in motion. This is a tremendous advantage. The same characteristic of requiring no intervening construction between the terminals gives radio a considerable advantage when long distances are to be covered, especially when all or part of the distance is over water.

b. There are, however, many limitations of radio communication. Possibly the most important from

a military point of view is that the messages carried by radio can be and generally are intercepted by an enemy. By intercept and allied means the enemy may break down the cryptographic system which protects the messages and read the messages themselves. He may also determine by direction finding the location of the station, and by traffic analysis of our radio nets estimate closely our dispositions and possible intentions. The possibility of enemy intercept varies with frequency. For further discussion, see h below.

c. Radio is also susceptible to interference. Such interference may be from static, it may be deliberate on the part of the enemy, or it may be accidental on the part of our own radio stations. Two radio stations must be tuned to the same frequency if they are to work one another. If a friendly station transmits on a frequency too close to their frequency, the result is interference which may be severe enough to prevent successful message transmission. The enemy may deliberately seek out this frequency and by transmitting on it, "jam" the radio communication on that frequency. Radio is, therefore, vulnerable to other radio, whether friendly or enemy.

d. Each of the great number of radio nets required by military forces must have its own frequency, which frequency must have certain separation from the frequencies operating nearest to it in order to avoid interference. Since the radio spectrum is limited, the tendency is to minimize this separation as much as possible and to use frequency control methods which will hold the radio station

closely to its assigned frequency. The methods of frequency control tend to make the radio station inflexible as to frequency, that is, it deprives the radio of the ability to change to more than a limited number of prearranged frequencies.

e. The distance and reliability of radio communication are determined by the frequency, the power used, the antenna, the condition of the terrain, and atmosphere between the two stations, method of modulation, and the proficiency of operating personnel. The usable frequencies vary widely and the transmission characteristics vary even more widely with the frequency used. The frequency classification and characteristics are given in table I.

f. A radio station, when transmitting, emits both a ground and a sky wave. The ground wave, as the name suggests, travels along the ground. It rapidly weakens and only by the use of high power in the radio station can communication by ground wave be maintained over considerable distance. On small sets, the ground wave may be strong enough to transmit for only a mile or a few miles. The sky wave goes skyward and for certain frequencies is reflected back to earth at a distance beyond where the ground wave has died out. On the high frequencies, it is possible to transmit over long distances by the sky wave and with very much less power than would be required to transmit by ground wave. The transmission by sky wave is dependent upon atmospheric conditions and the results vary also with frequency. Thus a long range station must have two or three frequencies assigned it to permit the selection of a suitable frequency which

will permit successful transmission under the existing atmospheric conditions. Under certain atmospheric and terrain conditions, it frequently will be impossible to obtain normal results from a radio set on any frequency. Finally, at very high and ultra high frequencies, neither ground nor sky wave will serve; there must be line-of-sight transmission between the two stations.

g. The antenna is extremely important. The radio set may be very powerful but if the antenna is small or improperly tuned or located, only a part of the available power is radiated from the antenna. The military limitation on the size of the antenna of many radio sets prevents such sets from utilizing properly the full power of the set. Suitable location of the antenna is equally important in successful operation, but military considerations frequently prevent use of ideal locations and force the radio set to operate at less than its possible range.

h. Beginning with the very-high-frequency-band, the radio waves act more and more like light waves as the frequency increases. Because of this and also because of the physical design of the antenna, the radio waves can be easily concentrated into beams. By the use of a highly directional antenna, such as the focusing parabolic type, the radio beams can be made relatively narrow and directed, much in the manner of a searchlight, at the point where reception is desired. The use of such a system both increases the relative power reaching the desired point and denies or greatly lessens the ability of the enemy to intercept the transmission.

Table I. Frequency Classification and Characteristics

Designation of band	Frequency (in mega- cycles)	*Normal use								
		1	2	3	4	5	6	7	8	9
Very-low-frequency (v-l-f)	below 0.03									
	0.03	X								
		X								
Low-frequency (l-f)	0.1	X	X							
		X	X							
	0.3	X	X					X	X	
			X					X	X	
Medium-frequency (m-f)	1.0		X	X				X	X	
			X	X				X	X	
	3.0		X	X				X	X	
					X	X		X	X	
	6.0				X	X	X	X	X	
					X	X	X	X	X	
	8.0				X	X	X	X	X	
High-frequency (h-f)	12.0					X	X	X	X	
							X	X	X	
	25.0						X	X	X	
								X	X	
	30.0							X	X	X
Very-high-frequency (v-h-f)									X	X
	300.0								X	X
Ultra-high-frequency (u-h-f)										X
	3000.0									X
Super-high-frequency (s-h-f)										X
	30000.0									X
Extremely-high-frequency (e-h-f)	300000.0									X

*Notes:

1. Ground wave over long distances, primarily in northern latitudes.
2. Used mainly for ground wave transmission for moderately long circuits over water and for moderate to short distances over land.
3. Nighttime sky wave transmission over relatively short distances (0 to 200 miles).
4. Daytime use over relatively short distances, provided antennas are used which radiate well in a nearly vertical direction.
5. Long distance sky wave transmission at night.
6. Long distance sky wave transmission during the day.
7. Ground wave transmission for relatively short distances over land or moderate distances over water.
8. Ground wave transmission over short distances.
9. Line-of-sight.

19. TELEPHONE. a. There are three common types of telephones in use by the Army. The "sound-powered" telephone uses no source of power other than that of the voice speaking into it. As a result, it has only a short talking range. It is useful for point-to-point conversations by front line troops who find its light weight and portability a great advantage. The "local battery" telephone contains dry batteries which furnish the power for amplifying the voice when the voice vibrations are converted into electrical current. The local battery telephone can be used on either a magneto or common battery switchboard. When used with the magneto switchboard, the telephone user must ring to call the operator and ring again when through talking to signify the end of a conversation or to recall the operator. This chore on the part of the user, plus the requirement of changing batteries and the number of dry batteries consumed, make it more efficient to use the "common battery" telephone whenever its use is practicable. The common battery telephone receives its electrical power from current fed to it from a source at the switchboard; hence, the name "common battery". This feature does away with batteries in the telephone and greatly reduces the consumption of dry batteries. It also permits the telephone user to signal the operator by merely removing the handset from the hook-switch or by replacing it thereon. The common battery telephone does not function well when too far distant from the switchboard to which it is connected; its use is limited by this characteristic

to situations where a considerable number of phones are located fairly close together. The local battery telephone will talk over greater distances than a common battery telephone.

b. A special type of local battery "amplifying telephone" enables a user equipped with this phone to increase the operating range of all circuits which he may choose to use. A switch in the handset handle when in the neutral position amplifies the incoming signal and, when in the "on" position, amplifies the outgoing signal. The normal operating range of field wire circuits can be doubled by use of this phone. It is particularly useful to commanders who normally receive calls from remote places or in fire direction centers and similar installations for use in communicating with forward observers and the like. This phone is, in effect, a terminal amplifier which, through manual control, amplifies both the transmitting and the received signal in turn. It is unnecessary to have more than one of these phones in any circuit connection between two subscribers.

c. The magneto switchboard is light and is suitable for use with local battery telephones. Consequently, these are used in the forward areas or wherever telephone users are widely scattered. The common battery switchboard is considerably heavier and more complicated and is, therefore, not suitable for front line use. Common battery switchboards include "magneto lines" which terminate in local battery telephones located too distant for satisfactory operation with common battery telephones.

d. The number of telephone operators required for magneto switchboards is greater than for common battery switchboards. The economy of personnel as well as speed of service make the use of common battery switchboards desirable whenever practicable. A further saving of operations personnel may be made by converting the common battery system to dial operation. In field conditions, however, this economy can rarely be obtained since most tactical switchboards handle a high proportion of trunk calls (calls going through two or more switchboards), and to handle these calls, operators are required. Also, dial operation requires up-to-date directories or else the user must call operator to get his call placed. These factors and the greater difficulty of installing and maintaining dial equipment tend to restrict the use of dial telephone systems by the Army in the field.

e. The range of telephone conversation is greatly dependent upon the circuits which connect switchboards. Such circuits are called trunks. They may be wire, radio, or a combination of the two. Any wire circuit described in paragraph 17 may be used as a trunk. When wire trunks exceed certain lengths (determined by the type of wire used in the construction), it is desirable to use carrier equipment or a suitable type of repeater, or both. Carrier equipment provides higher quality circuits and permits the transmission of several telephone conversations simultaneously. Nearly all wire circuits between headquarters down to and including regiments will be operated with carrier. The limitation on use of carrier is that the equipment necessary to

convert a simple circuit to carrier is heavy and complicated and cannot be taken forward to the front line troops below regimental level. Repeaters must be inserted in the circuit to maintain the energy at its initial level. By use of repeaters on high grade circuits, the telephone may have a wire range of several thousand miles. The installation, operation, and maintenance of carrier and repeater equipment require highly skilled personnel. The operation of trunk circuits along a route must be controlled from a single point from which instruction to carrier and repeater personnel and to maintenance crews are transmitted. Unified control is absolutely essential to successful operation of such circuits.

f. The telephone may also be used over radio circuits. In tactical field sets, the telephone communication is point-to-point. However, the trunk circuits between switchboards may be radio instead of wire and these may have carrier applied to them and be repeated. The carrier equipment used is the same as that for wire but does require some additional equipment to apply it to a simple radio circuit. To repeat or extend a radio circuit requires two radio stations back to back and the equipment is greater than that required for a wire circuit. The most promising military development in signal communication is the radio relay system. This system, using very high frequency and line-of-sight transmission can be installed more quickly than wire, be used for trunks until wire circuits are installed and then moved, if necessary, to localities where telephone trunks must be installed quickly.

Its development in the near future may permit it to replace wire circuits altogether in trunk construction.

g. It is most important in war for users of the telephone to understand the relative security inherent in different types of circuits. The circuit from a subscriber to a switchboard can always be tapped by unfriendly personnel in the vicinity. Circuits between switchboards can similarly be tapped with a varying degree of ease. Tapping carrier circuits requires relatively complex technical equipment which in itself is difficult to conceal or apply to a well constructed circuit. The relative signal communications security thus obtained from carrier circuits which are protected from tapping by infiltrating enemy forces or unfriendly inhabitants is often sufficient to justify the use of such circuits for transmission of classified material in clear. Similarly, the use of the radio relay for telephone communication gives relative immunity to enemy interception and when the radio relay is used with carrier, the signal communications security resulting is high. If such circuits are cleared for transmission of classified material, they must still be used with extreme care. The chain is only as strong as its weakest link and it is the weakest part in the overall telephone circuit set up in any connection that determines the signal communications security of the overall circuit. It must be remembered that no simple two-wire telephone circuit near the front, no simple two-wire circuit anywhere among unfriendly inhabitants, no radio link circuit in a telephone system employed under similar conditions

is secure against enemy interception. Therefore, when an overall telephone connection contains any such weak links, there is no signal communications security merely because the major part of the overall circuit is secure. For this reason, a high degree of telephone discipline must be observed by telephone users in a system, part of which is cleared for classified transmission in clear and part of which is not.

h. The goal of signal communications security research is a simple lightweight device incorporated with each telephone, radio, or wire, which shall at the talking end convert intelligible speech into indecipherable electrical impulses as the voice passes through the telephone onto the circuit and which, at the receiving end, reconverts it to intelligible speech. A satisfactory device of this type is not now available and consequently the telephone must be used with extreme care. Commanders and staff officers using telephone circuits of any type must be thoroughly familiar with the relative signal communications security of the circuit they are using and telephone operating personnel must be thoroughly prepared to give information to telephone users as to the security of circuits over which users are placing calls.

20. TELETYPEWRITER. **a.** Teletypewriter communication possesses several very considerable advantages. Automatic telegraphy is so similar to teletypewriter communication that the two may be classed together. Teletypewriter can be used on wire or radio to replace manual telegraph wherever

the circuit is of sufficiently high quality to carry teletypewriter signals. The speed of a teletypewriter, especially when using automatic transmission, is higher than that of manual telegraph and the teletype operator requires far less training and ability than the manual telegraph operator. Teletypewriter can transmit punctuation, symbols, and text arrangement so that the received message is more directly readable. Another advantage of teletypewriter over the manual telegraph is that with some additional equipment, the teletypewriter may be switched to connect directly two users just as two telephones are connected for conversation. As compared to the telephone, the teletypewriter has the advantage of furnishing both parties a written record of messages or information exchanged. Also, on any circuit on which carrier is used, there can be substituted for any one telephone channel four or more teletypewriter channels and a greater signal communication use can thus be made of the circuit.

b. The simplest use of teletypewriter is from point-to-point as between two communication centers or in unusual circumstances to connect directly two individuals or activities whose need for such service meets the requirements of allocation covered in paragraph 7. Point-to-point teletypewriter facilities are used to transmit not only messages between the two points but also those which must be relayed from other points in the process of transmission. When the volume of traffic justifies it, provision may be made for automatic relay of traffic.

c. In divisions and higher units teletypewriters are the principal means of transmission used by communication centers. These may be connected directly or through the teletypewriter switchboard to any other user of a teletypewriter switchboard exchange.

d. In addition to the above, there may be furnished to users teletypewriter switchboard exchange service by which any user connected to a switchboard of the system can be connected to any other user similarly connected. This service is of great value for administrative and supply work, if the circuits over which it is used are sufficiently secure to permit transmission without encipherment. Use of this teletypewriter exchange service frees the communication centers of a great volume of low priority traffic, gives the users more rapid service and permits typewritten conferences between users. It should be used only for transmissions of routine matters which are authorized between staff sections without final approval of the commanders concerned. The operators for such teletypewriters are furnished by the user concerned.

e. The chief disadvantage of the teletypewriter are the weight and complexity of the machine itself and of the associated equipment which must include a power supply. This weight prevents the use of teletype in front lines, in airplanes, and in similar cases where weight is a governing factor. Signal communications research and development is striving to produce a teletypewriter whose simplicity, weight, and bulk will permit it to be used more extensively.

f. With one exception, the discussion of signal communications security pertaining to telephone communication in paragraph 19g applies also to teletype communication. This exception is extremely important. There is a device applicable to the teletype at each end of the circuit which renders the transmissions secure and yet allows the teletypes themselves to print clear text. This device and its associated equipment is at present too bulky, heavy, and complicated to permit widespread use. It is the object of signal communications research and development to improve this device or to produce a substitute so that automatic encipherment and decipherment may be used whenever a teletype is used.

21. MANUAL TELEGRAPHY. Manual telegraphy is used in the Army under those circumstances when teletype communication is impracticable and written messages are to be transmitted electrically. The advantage of telegraphy is the small amount of equipment required for the operator to control the circuit. Consequently, manual telegraphy is used in the vicinity of the front lines, when net operation is essential, and in certain circumstances in air-ground communication. It is also used on many circuits where the volume of traffic does not justify the installation of expensive teletypewriter equipment. Telegraphy will also operate over a poor circuit which is impossible for teletypewriter communication but only if skilled operators are available. The chief disadvantage of telegraphy is that nine months to a year of training and experi-

ence are required to produce a good operator. Even a good operator cannot attain and sustain the speed of a teletypewriter that is transmitting tape. As indicated in paragraph 20, it is expected that ultimately teletypewriter communication will replace all manual telegraphy.

22. FACSIMILE. Facsimile comprises the transmission by electric signaling of fixed graphic material including pictures, sketches, text and handwriting. Pictures (including photographs taken from airplanes), map overlays, and sketches may be valuable means of transmitting information. The art is a comparatively new one in electrical communication, and experience has shown that it can be very valuable when put to a use for which it is adapted and when its characteristics and restrictions are clearly understood. Its military usefulness is still in the formative stage, and any specific proposed application requires consideration of what service is desired and what may reasonably be expected to be accomplished. Advantages of this equipment are its ability to transmit sketches, photographs and the like at a rapid rate. For example, a 4- by 5-inch sketch can be transmitted in about 7 minutes; a 12- by 17½-inch sketch in about 30 minutes; and 50 inches of handwriting in 1 minute. Its disadvantages are that high quality electrical circuits, radio or wire, are required for transmission of any material; it is slow; the size of subjects to be transmitted is limited; and in the transmission of photographs there is a varying degree of distor-

tion of the received image. At present, there is no signal communications security for facsimile transmission. Highly skilled technicians are required for the installation and operation of this equipment. All equipments may be employed utilizing either wire or radio circuits.

23. PIGEONS. The widespread use of radio in conjunction with the airplane to contact and supply isolated parties has rendered the use of pigeon communication nearly obsolete. In order to preserve the art of pigeon communication for the time being, a central breeding loft will be maintained in peacetime and pigeons will be furnished to theaters as project material. Training in pigeon communication will be conducted only when the need for it is foreseen in an operation or series of operations.

24. VISUAL AND SOUND COMMUNICATION. These subjects are treated together because they are special purpose means of communication. Their nature is such that they are applicable only to short range communications, certain situations, and usually by means of prearranged codes.

a. Visual communication is accomplished by flags, as in the control of columns of vehicles; panels, as in air-ground communications; pyrotechnics for prearranged signals where applicable; and lights where applicable, such as in control tower operations. Communication with signal lights using Morse code is sometimes useful but is relatively slow.

b. Visual communication is by nature limited by

adverse weather conditions and by the distance over which observers can read the signals, and is restricted to line of sight. It is susceptible to enemy interception when used near enemy troops.

c. Sound communication is more limited in usefulness for military purposes than is visual communication, due to its lesser range. It is used for prearranged codes, such as the sounding of alarms by means of gunfire, sirens, horns, gongs, whistles, and the like.

25. PRINCIPLES OF USE. a. There are two objects always to be kept in mind when employing the various means of signal communication. One is speed of installation by which facilities may be made available to the commanders and staffs at the time of first need. The other is signal communications security which permits the freest and fullest use of the facility installed.

b. Radio telegraph will continue to be the most suitable for quick installation and its security will be that of the cryptographic means used. It will be used for mobile radios and for initial installations at command posts. When circumstances permit and traffic volume requires, it will be replaced as quickly as possible with radio teletype. The radio teletype may or may not have automatic cryptographic attachments.

c. The radio telephone will also be used for mobile radios and may be installed initially at command posts in addition to radio telegraph or radio teletype. Until an appropriate security device is developed, it remains the least secure signal com-

munication facility furnished to commanders and their staff. Its use must, therefore, be restricted to those who have been fully trained in its proper use.

d. The main burden of electrical communication will be carried by the telephone system. Initially this will consist of radio relay circuits to which carrier and repeaters are applied as quickly as possible. Both telephone and teletype will be used over such circuits. Although radio relay may be more quickly installed over a long distance than equivalent wire facilities, it has not yet proven to be more economical than wire when a considerable number of communication channels must be provided. Therefore, it will be normal to construct wire circuits as rapidly as possible to replace the radio relay system and permit the radio relay system to be shifted to another area where speed of construction and installation is essential. Essentially, the practice will consist of pioneering in new areas with radio relay and then replacing it with wire communication. At the stage of development when radio relay becomes as economical as wire communication for providing numerous channels along a given route, it will wholly replace wire communication for trunking construction.

e. The trunking system connects into switchboards which serve the telephone and teletype users. In the area surrounding a switchboard, radio is not suitable or economical for connection of users to the switchboards. Wire connection of suitable type will continue to be the rule for short trunks and for connecting teletype and telephone users to switchboards.

f. In setting up any new signal communications system, the object is to give prompt and adequate service to the commander and his principal staff officers rather than to construct complete facilities to serve the entire command. To this end, the system is pushed to completion as a skeleton and is amplified and reinforced continuously thereafter as long as the unfulfilled need for signal communications exists.

g. Messengers are used to distribute messages locally and to carry bulky and other material the electrical transmission of which is not justified. When no other means of signal communications exists, the messenger must be used.

SECTION III

DEPARTMENT OF THE ARMY SIGNAL COMMUNICATIONS

26. RESPONSIBILITIES OF THE CHIEF SIGNAL OFFICER. The principles set forth in preceding sections apply equally in all echelons, but the manifold and important responsibilities of the Chief Signal Officer deserve amplification. For the purpose of this manual, responsibilities which do not pertain to signal communications are not discussed.

a. The Chief Signal Officer is responsible to the Secretary of the Army and the Chief of Staff for signal communications within the Army and for all matters pertaining thereto. He discharges his duties and meets his responsibilities by acting both as a staff officer and a commander. The integration of the entire Department of the Army signal communications system, its standardization and adequacy, are his responsibility. As a commander the Chief Signal Officer operates that part of the Army signal communications system providing global communications and known as the Military Command and Administrative Network. As a staff officer he exercises technical direction and control which integrate and standardize theater signal communications systems and signal communications in combat areas. As a staff officer he plans and coordi-

nates adequate supply of signal communications personnel and equipment; as a commander he develops, standardizes, procures, stores, and issues the equipment and accomplishes a part of the procurement and training of personnel.

b. Signal communications plans and actions must conform to the overall objectives and plans of the Department of the Army. The Chief Signal Officer, therefore, maintains close liaison with all planning activities of the Department of the Army and coordinates as may be necessary before taking direct action in the name of the Department of the Army or presenting recommendations to the Chief of Staff, with appropriate sections of the General Staff, United States Army, and with major commands such as armies and overseas commands.

27. MILITARY COMMAND AND ADMINISTRATIVE NETWORK (MCAN). **a.** This global network consists of all long distance circuits in the zone of interior; those long distance circuits which link the Department of the Army to overseas commands; the Department of the Army Communication Center; and such other communications centers and relay stations as may be necessary. The construction, maintenance and operation of this network is the direct responsibility of the Chief Signal Officer and is performed by personnel under his direct control, command of these troops being exercised as described in paragraph 3. Those stations forming the distant end of the overseas circuits and which are also part of the theater signal communications system are operated by troops under control

of the theater commander, but the stations are under technical control of Military Command and Administrative Network.

b. Within the continental United States, MCAN uses primarily circuits leased from commercial communication companies, except when military circuits are more desirable for purposes of training or security. MCAN constructs such signal communications facilities as cannot or should not be obtained by lease from commercial companies.

c. Acting for the Department of the Army, the Chief Signal Officer allocates circuits of MCAN for the use of major commands and activities in accordance with the principles of paragraph 7, within budget limitations, and so as to make the best possible use of available circuits. For convenience or economy of operation, major commands may be directed to maintain and operate a portion or all of certain circuits, especially when such circuits have been allocated to a major command.

d. The Military Command and Administrative Network serves other government departments and agencies when this can be done without undue delay to message traffic of the Department of the Army. It also makes the necessary arrangements for contact with commercial communications networks and the refile of messages over such networks.

e. Responsibility for signal communications security in the Military Command and Administrative Network rests upon the Chief Signal Officer.

f. The Military Command and Administrative Network also organizes and maintains special teams

for the installation of unusual and special equipment. These teams are sent where needed throughout the Army to install such equipment when the installation is beyond the normal means of the theater or major command requiring the installation. These teams remain after completion of installation for a "breaking in" period in order to instruct the operating and maintenance personnel on the equipment.

28. MAJOR COMMANDS, THEATERS, ETC.

The integration of signal communications systems of theaters, major commands, etc., their standardization, adequacy, etc., is accomplished by technical supervision and by technical control.

a. In the following matters the Chief Signal Officer acts directly in the name of the Department of the Army and the Chief of Staff:

(1) Review and approval of all major projects relating to the installation, maintenance and operation of fixed signal communications systems and facilities for the Army.

(2) Preparation and supervision of policies and procedures relating to the coordination, integration, and standardization of signal equipment (except equipment designated by the Department of the Army as peculiar to the United States Air Force) and signal communications systems of the Army with those of the Navy, Air Force, and foreign powers.

(3) Promulgation of standing operating procedures governing the operation of Army signal communications equipment.

(4) Supervisory control over the assignment of call signs, radio frequencies, power and types of emission for all Army radio stations, and coordination of these matters with other military and government agencies.

(5) Study, preparation and dissemination of information concerning radio propagation within the Army and contact with other government agencies and foreign governments concerned with radio propagation information.

(6) Subject to the provisions of AR 310-10, preparation and revision of publications dealing with the technical and military characteristics of signal equipment.

(7) Preparation of final estimates for and primary administrative control over Signal Communications Service of the Army funds.

(8) Establishment and operation of schools and facilities required for the training of units under his command and for the training of signal and communications specialists of the Army for which he is responsible.

(9) Standardization of items of signal and communications equipment and supplies for the Army, except those items designated by the Department of the Army as the responsibility of other agencies.

(10) Maintenance of a roster of Signal Corps officers, warrant officers, and enlisted men of the first three grades; and the career guidance of Signal Corps officers, warrant officers, and enlisted men of the first three grades.

(11) Subject to the provisions of AR 310-10, preparation and revision of all technical publications, directives, and instruction data covering general policies, procedures, standards and methods of a technical nature pertaining to signal communications equipment and supplies (except those designated by the Department of the Army as peculiar to the United States Air Force).

(12) Technical inspections of the major commands, theaters, etc., as may be desirable to determine compliance with and understanding of Department of the Army directives concerning signal communications and signal communications equipment.

(13) Technical assistance to the General and Special Staffs, United States Army, heads of administrative and technical services, the major commands, theaters, and other commands.

b. In the following matters the Chief Signal Officer makes recommendations to the Secretary of the Army and to the Chief of Staff.

(1) The assignment of implementing responsibility to and between major commands in matters pertaining to signal communications.

(2) Responsibility of the major commands and agencies of the Department of the Army for overall requirements of training, movement and supply of signal communications units within the Army.

(3) Formulation of broad training objectives and doctrine for all signal communications units within the Army.

(4) Responsibility of the major commands and agencies of the Department of the Army for the training and supply of those signal communications specialists having MOS designations common to the Army as a whole.

(5) Selection and procurement of personnel for signal communications troops of the Army.

(6) Organization and equipment tables of all signal communications units within the Army to insure uniform use of equipment and to eliminate duplication of personnel.

(7) Job classification requirements (MOS and SSN) for signal communications personnel to insure uniformity throughout the Army.

(8) Establishment of such boards and committees as he deems essential for the overall coordination of matters dealing with signal communications and Signal Corps functions within the Department of the Army.

29. SIGNAL SUPPLY. The words "signal communications equipment" in this paragraph shall be understood to mean "all items of signal communications equipment and supplies required for the Army except those signal communications equipment and supplies which have been determined by the Department of the Army to be peculiar to the United States Air Force."

a. The Chief Signal Officer functions in supply matters as both staff officer and commander. As a staff officer, he formulates and coordinates with interested staff sections and major commands,

Army-wide plans, policies, and programs for the research, development, design, standardization, procurement, storage, issue, and maintenance of all items of signal communications equipment and supplies required by the Army, except those signal communications supplies and equipment which are determined by the Department of the Army to be peculiar to the United States Air Force. When such Army-wide plans, policies, and programs have been coordinated and approved, the Chief Signal Officer, as a commander, becomes responsible for their implementation. He, therefore, establishes and operates such Signal Corps procurement districts, branch depots, signal sections of general depots, laboratories, and other facilities as are required to execute the approved plans, policies and programs.

b. To provide the Army with the most efficient signal communications equipment, the Chief Signal Officer carries on continuous research and development designed to improve existing equipment and to utilize the advances of science in new types of equipment. The Army is furnished, so far as budgetary considerations permit, up-to-date equipment. Stores of such equipment are not acquired for purposes of mobilization. Instead, plans and programs are formulated in peacetime so that industry can be ready at the onset of an emergency to manufacture quickly the required volume of latest type equipment. Plans for this wartime production are coordinated to insure that the necessary manufacturing plants and the essential raw materials are allocated. Production plans for allocated plants are kept in readiness and when new manufacturing

processes are concerned, manufacturers are prepared for this use by procurement of sufficient magnitude to test out production and provide essential machine tools. The objective of signal communications supply is a peacetime Army equipped with the best equipment obtainable, but the reserve equipment for the Army's expansion is contained in the certitude that plants capable and ready to manufacture the needed equipment have been allocated for the purpose and have been assured of the necessary raw materials.

c. To achieve simplicity in supply, constant effort is made to standardize the parts and components in use and to minimize the number of different types required. This standardization is coordinated, as far as possible, by means of boards, agencies, etc., with the United States Air Force, the Navy, and, in time of war, with allies.

d. When as the result of research and development, new types of signal communications equipment are standardized for use in the Army, the Chief Signal Officer obtains the recommendations of the major commands and using services as to their needs and recommends to the Chief of Staff the basis of issue for such equipment. Upon approval of his recommendations, it then becomes his duty to supply such equipment to the Army, coordinating as may be necessary for budgetary means, or in time of war for raw materials, etc. When the equipment is issued, the Chief Signal Officer is responsible for provision of all technical literature pertaining to its use, maintenance, care, and supply.

e. The Chief Signal Officer is responsible for the storage in branch depots of all items of signal communications equipment and for issue in the name of the Department of the Army of technical instructions concerning care, storage and maintenance of signal communications equipment throughout the Army. Inspections are made for the Department of the Army to insure that such instructions are understood and complied with. Issues are made in the zone of interior to posts, camps, and stations upon receipt of approved requisitions. Issues are made to theaters and oversea commands upon receipt of approved requisitions or projects, except during the period of automatic supply which immediately follows the establishment of a new theater or oversea command. As a staff officer, the Chief Signal Officer participates in the planning by which priorities for issue of equipment and supplies are established and when such priorities have been established, he issues in the name of the Department of the Army instructions for submission and approval of requisitions and projects necessary to implement the priorities. The approval and filling of requisitions is decentralized as much as possible; however, all major signal communications projects must be approved by the Chief Signal Officer prior to issue of the signal communications equipment required.

f. When a new theater or oversea command is to be established, the signal communications requirements are calculated. These requirements include the signal communications equipment immediately necessary; that for establishment of the approved

number of days supply in the depot system; that for projects to implement theater plans approved by the Department of the Army; sufficient signal communications equipment to establish pools of reserve equipment at each echelon of command; a reserve of project equipment constituting an advance shipment against theater projects yet to be submitted and approved; and that required for replacement and maintenance during the estimated period of automatic supply. If the new theater cannot be supported with this total requirement, the Department of the Army and the theater commander must be informed so that the theater plans may be altered, if necessary, to meet the short supply situation. Once the general plans of the theater and their relative priorities are approved by the Department of the Army, it is the responsibility of the Chief Signal Officer to approve requisitions and projects for that theater within the Department of the Army policy and to effect expeditious supply to the theater. It is improbable that all theaters, oversea commands, and the zone of interior can be supplied with all the signal communications equipment desired, especially during the early stages of an emergency. For full utilization of equipment, stock control is absolutely essential. The Chief Signal Officer, therefore, prescribes in the name of the Department of the Army the methods of stock control to be used throughout the Army for signal communications equipment and makes such inspections as may be necessary to insure their being understood and complied with.

g. The issue of new types of signal communications equipment during war will not be made until the literature necessary for use and maintenance of the equipment is ready for simultaneous issue and maintenance parts are available. As far as possible the issue of new types of equipment will be accompanied by teams especially organized and trained to introduce the new equipment to the troops who must use and maintain it.

30. SIGNAL COMMUNICATIONS TRAINING.

a. As a staff officer the Chief Signal Officer makes recommendations to the Chief of Staff, after coordination with those concerned, on the following training matters: broad training objectives and doctrine for all signal and recomunications units of the Army, the assignment to major commands of responsibility for training of signal communications personnel as individuals and of signal and communications units, standards of skill for qualification in the job classifications (MOS and SSN) pertaining to signal communications, and standards of proficiency for units to attain prior to shipment to oversea theaters. His staff duties include such inspections as are necessary to insure that the objectives of training and standards are met.

b. Success in signal communications requires a high degree of specialist training. The operation of the Military Command and Administrative Network, the theater signal communications systems, and the combat signal systems, as an integrated system demands that the individual training be uniform and standardized which is best accomplished by

training under a single head. In time of war, experienced trained personnel is limited and those available are best employed in large training installations. The Chief Signal Officer establishes and operates such schools and other training facilities as may be required to receive inductees intended to be qualified as signal communications specialists having MOS and SSN designations common to the Army as a whole. These inductees will be classified, trained and qualified and then furnished as filler and loss replacements. The responsibility for team and unit training under standards and objectives set by the Department of the Army will be assigned to the major commands.

c. Administrative or operational limitations may prevent training of all common signal communications specialists under centralized control by the facilities of the Chief Signal Officer. He will, in such case, continue to train those common signal communications specialists who experience shows cannot be successfully trained by on-the-job methods in units, and will operate such Signal Corps schools and training facilities as may be required and authorized for the purpose.

d. In time of peace, one of the chief responsibilities of the Chief Signal Officer is the career guidance and training of Signal Corps officers. Although the demands of modern signal communications call for a high degree of specialized knowledge and skill, the careers of officers are so planned that they will not become one-sided. While an officer may be outstandingly qualified in a certain signal communications specialty, his overall training must be

sufficiently broad to enable him to fill creditably several other types of positions in the signal communications field. Only by such diversified training can officers be prepared to accept the broadened responsibilities which are placed upon them in war. A similar policy is followed so far as practicable in the training of noncommissioned officers of the first three grades.

31. SIGNAL COMMUNICATIONS PERSONNEL.

a. The Chief Signal Officer is the advisor of the Secretary of the Army and the Chief of Staff in all matters affecting particularly signal communications personnel, and such matters should be coordinated with him by Divisions of the General Staff, United States Army, and by the major commands. Among matters of vital concern are—

(1) The procurement and assignment of an adequate number of personnel having qualifications which render them suitable for signal communications training to fill all the demands for signal communications troops.

(2) The procurement of affiliated units for signal communications and Signal Corps needs of the Army.

(3) The assignment and reassignment of Signal Corps officers, warrant officers, enlisted personnel of the first three grades, and key signal communications specialists.

(4) The approval of bulk requisitions for replacements by theaters, major commands, and oversea commands.

(5) Promotion, retirement, etc., of Signal Corps officers and enlisted men.

(6) Replacement rates of *all* signal and communications personnel.

(7) Operation of the replacement system to the end that qualified signal communications personnel are produced and delivered in the numbers required at the time needed from the replacement system.

(8) Procurement of personnel sufficiently in advance to permit their training in time to be used in trained units for theaters and operations planned for the future.

b. As a commander, the Chief Signal Officer has the normal responsibilities and duties of a commander with respect to personnel.

32. SIGNAL COMMUNICATIONS PLANNING.

a. The Chief Signal Officer participates in all Department of the Army planning to insure that adequate signal communications facilities, troops, equipment, and supplies are provided to meet the necessities of command. When it appears that Department of the Army plans cannot be supported by adequate signal communications he gives timely warning to all concerned. In all signal communications planning he acts for the Department of the Army in coordinating with the U. S. Navy, U. S. Air Force and other Government agencies and foreign governments if necessary.

b. Plans must be coordinated to insure that every phase of signal communications is provided for. This requires up-to-date study of requirements for equipment supplies, troop units and personnel. Planning continues by determining the sources,

methods of procurement, training, etc., essential to providing the means at the time they will be needed. Especially important is the duty of the Chief Signal Officer to foresee and plan for the entire signal communications needs of theaters to be activated or operations to be undertaken in the future. The commanders and signal officers of theaters of operations are seldom appointed or assigned much in advance of activation or short range planning stages: they cannot study and present requirements in time to permit procurement of the necessary equipment and supplies and the procurement and training of the essential personnel. It is the duty of the Chief Signal Officer to foresee by active planning all such requirements and to initiate in the Department of the Army action to provide in the quantity needed and at the proper time the entire means which such theater commander and their signal officers will require.

c. Similarly, the Chief Signal Officer must maintain an up-to-date knowledge of the civil communications systems of the world with the electrical characteristics of each, the indigenous materials, raw or finished, likely to be found in potential theaters of operations, and characteristics of signal communications equipment in use by other nations of the world. In these matters the Chief Signal Officer and theater signal officers must coordinate and exchange information with the Director of Intelligence, General Staff, United States Army, and theater intelligence agencies. This equipment is available for both his own planning and for the planning of theaters and major commands.

SECTION IV

THEATER SIGNAL COMMUNICATIONS

33. GENERAL. Whereas in the zone of interior, primary reliance is placed upon existing or expanded commercial communications, all signal communications in theaters are controlled by the military and all or the major part is operated, constructed, and maintained by the military. The responsibilities of command with respect to signal communications in theaters are many and are stated in subsequent paragraphs in terms of the duties of the theater signal officer, it being understood that these duties are merely delegations of authority to the signal officer from the theater commander.

34. THEATER SIGNAL COMMUNICATIONS SERVICE. a. The manner of controlling signal communications in the combat zone and in the communication zone are somewhat different. In the combat zone, cohesion requires that each commander control the signal or communications troops who construct, maintain, and operate his own signal communications. Each commander, however, exerts himself to make all signal communications within his unit operate as a single integrated system. In the communication zone, conditions more

nearly approach those in the zone of interior and more centralized control of signal communications produces better service with a given number of personnel than can be attained with divided responsibilities.

b. In the communication zone, therefore, the theater signal officer organizes the Theater Signal Communications Service. Communication zone activities are provided only those signal communications troops who are required to construct, maintain, and operate its local signal communications facilities and those point-to-point radio circuits which are the minimum command requirements for operations; all other signal communications troops are pooled to form the theater signal communications service. The commander of the theater signal communications service, operating directly under the theater signal officer, constructs, maintains and operates the long-distance signal communications system in the communication zone. This system consists of wire facilities, radio facilities, combinations of the two, and courier service. The system also operates Signal Centers and long distance switchboards in appropriate localities and local switchboards in those localities where displacement of several small switchboards by a single large one will improve telephone and teletype service.

c. Examples of the signal communications for which troops are provided for activities in the communication zone are the facilities required for local communications within base sections, port or depot areas, antiaircraft artillery operational circuits and flash warning circuits. As rapidly as the theater

signal communications system is constructed and channels become available, channels in the theater system are allotted to the users of such excepted circuits. The organizations, however, retain the personnel to operate the original circuits and keep the original circuits in standby operation.

d. The theater signal communications system is planned to serve the entire theater and to furnish long distance signal communications to all units and activities. It is planned with a view to expansion in those areas where activity may be expected to increase. Circuits required for operation of military pipelines and military railroads are constructed as part of the theater signal communications system; the circuits so provided for pipeline and railways are maintained by theater signal communications system personnel but are operated by pipeline and railway personnel. It follows that in the long distance system the route of long distance circuits will often follow railways in order to simplify construction and maintenance. The construction of facilities which will eventually be incorporated into the theater signal communications system is pushed forward into the combat zone as rapidly as possible and as far as the tactical situation will permit. The theater signal communications system must always reach at least the general line formed by the rear boundaries of armies. The theater signal communications system must always be pushed forward to give signal communications to the headquarters of army group and it should generally be engaged in construction well ahead of the army group headquarters. Such construction should

consist usually of strengthening the facilities already installed by troops under army group, which facilities should have been planned with a view to eventual incorporation into the theater signal communications system as the result of coordination by the theater signal officer. Similarly, it will usually be desirable to construct the theater signal communications system to afford service from army depots to base depots, etc., and from elements of the tactical air force to their air fields and administrative and supply bases in the communication zone. Where the theater network is being constructed within the combat zone the theater signal communication system should, whenever possible, utilize the routes already employed by major combat units, increasing the facilities existing rather than establishing duplicate facilities beside existing ones. The theater signal officer coordinates the construction so that the signal communications of the major unit is not interfered with and arranges a suitable time and procedure for the incorporation of the entire facility into the theater signal communication system without interference to the signal communications of the major unit. The construction troops of the major unit may be reinforced at the time of original construction for the specific purpose of constructing facilities adequate for eventual incorporation into the theater signal communications system.

e. In the planning and construction of the theater signal communications system, provision is made for other Government services operating in the theater and for the press. If a theater is allied,

provision must be made for coordinating the theater signal communications system to meet the needs of all allies in the theater and at the same time remain one integrated system for the whole theater. Where one ally is responsible for a specific sector, responsibility for the theater signal communications system in that sector may be delegated to that ally by the supreme theater signal officer.

f. The theater signal communications system makes maximum use of the existing communications system and of materials indigenous to the theater. The civilian population must be left that minimum of signal communications which will permit it to exist without becoming a burden upon the military and, if it is friendly, to assist the military effort to the maximum. The materials which are used to construct the theater signal communications system and which are not obtainable within the theater are obtained by submitting projects to the Department of the Army; T/O & E equipment and replacements therefor are incorporated in the system only in emergencies. It follows that the theater signal communications system must be planned in a broad way before the theater is activated and that forward planning for expansion of the system must be always months ahead of actual construction.

g. The theater signal communications system constructs and maintains long distance circuits up to the switchboard or similar installation of the users in the communication zone. In areas which are occupied by several units or activities, each of which has only a small switchboard, the system will install a single large switchboard to serve all users in the area and will likewise provide a communication

center to serve all in the area. In areas where there is a single large unit headquarters, the switchboard and communication center of the unit are the operating agency and the facilities of the large unit may be required to serve also small units in the vicinity. In areas where there are several large units it will usually be desirable to establish a long distance switchboard operated by the theater signal communications system and connected by local trunks to the switchboards of the units.

h. Circuits in the theater signal communications system are common user circuits except those which are allocated in accordance with the principles given in paragraph 7. Allocation is made by the theater signal officer, acting for the theater commander. Generally, the expansion of the system will favor the increase of allocated circuits. As rapidly as possible, the theater signal communications system should provide teletypewriter exchange service for the transmission of administrative and supply traffic. To obtain maximum effectiveness from the teletypewriter service and from the system in general, the theater signal officer must endeavor to obtain in the theater signal communications system sufficient signal communications security to permit transmission of classified material over the channels without resorting to cryptography.

i. The theater signal communications system must have a reserve with which to meet sudden contingencies. Although such a reserve is planned and created, it is not held in idleness awaiting emergency employment but is utilized in the normal construction, maintenance and operation of the

system. The theater signal officer constantly studies his employment and distribution of troops so that he can, with a minimum loss of time, reinforce an area in need of more troops, undertake new operations as the situation dictates, or reinforce combat troops should that become necessary.

35. RADIO COMMUNICATIONS. a. The theater signal officer is responsible for operation of those stations which join together the theater signal communications system and the Military Command and Administrative Network. In such operation, he follows the policies and instructions of the latter.

b. The theater signal officer represents the theater commander in all matters concerned with radio frequencies and call signs. In this respect he is responsible for the following:

(1) Coordination of the use of radio frequencies with Department of the Army agencies, with adjacent theaters, with the local naval and air commander, with allies and with friendly governments within the theater.

(2) The assignment of frequencies and call signs of all radio stations using enough power to cause interference beyond a limited range.

(3) Assigning blocks of call signs and frequencies for use with lower powered radio sets.

(4) Providing a monitoring service to enforce frequency and procedure discipline.

(5) Providing a central crystal source for the theater.

(6) Instituting action to correct and eliminate violations of radio frequency and procedure discipline.

(7) Obtaining from the Department of the Army radio propagation data, using such data in the assignment of proper frequencies and disseminating it to those in the theater who may need it.

c. The theater signal officer is responsible for the timely procurement and coordination of the allocation of signal communications facilities on headquarters ships for any amphibious operations conducted by the theater.

36. SIGNAL COMMUNICATIONS SECURITY.

a. The theater G-2 as part of his security functions is responsible to the theater commander for policies concerning signal communications security and the theater signal officer is responsible for signal communications security within the theater signal communications system. The theater signal officer is responsible for the timely inspection of all agencies within the signal communication system to insure that classified cryptographic material is properly safeguarded.

b. The theater signal officer makes periodic studies of message traffic and recommends to the theater commander action to correct practices which endanger cryptographic security. He is also responsible for reviewing message traffic to detect cryptographic violation and takes such corrective action as is necessary under policies promulgated by G-2.

c. He recommends to the theater commander circuits of the theater signal communications system which may be cleared for unencrypted transmission of classified messages in accordance with approved policies.

d. In all matters pertaining to cryptographic security, the theater signal officer coordinates with G-2 before submitting recommendations to the chief of staff.

37. SIGNAL SUPPLY. a. The theater signal officer is directly responsible for the organization and operation of the theater signal supply system. Personnel of theater signal depots and signal sections of theater general depots are under his command, though they are attached for administration and supply to a suitable and convenient headquarters. He determines the location of signal depots, stockages, etc., within the theater signal plan by coordination with G-4. He establishes an effective stock control system for signal supplies and in the absence of Department of the Army publications governing stock control by major commands and units, prepares such instruction for issue in the name of the theater commander. He determines and establishes the pools of equipment and supplies in excess of T/O & E's referred to in paragraph 9, and he approves in the name of the theater commander special issues in excess of T/O & E's or T/A's, including Special Lists of Equipment. He is responsible to the theater commander for the prompt and proper requisitioning of signal supplies and equipment from the zone of interior. He so directs the signal

supply system as to decentralize the editing of requisitions for all but such items as are in short supply. Such items are termed critical items and their issue is closely controlled by the theater signal officer and also by major units and commands.

b. The theater signal officer is responsible for the maintenance and repair of signal equipment, photographic equipment, and radar equipment which is not peculiar to the U. S. Air Force. He utilizes the repair sections of depot companies and repair companies assigned directly to theater headquarters to carry out his responsibilities. Successful maintenance and repair depend upon trained personnel and upon an adequate and prompt supply of spare parts. He therefore coordinates carefully the signal supply system with the maintenance and repair system. He is responsible for staff supervision of major commands and units in signal supply, maintenance and repair.

c. The theater signal officer may delegate to the signal officer of the communication zone (or service of supply) the operation of the signal depot supply system, but he continues to maintain close contact and supervision and his responsibility to the theater commander for prompt and adequate signal supply remains undiminished.

38. SIGNAL COMMUNICATIONS PERSONNEL.

a. The theater signal officer is responsible to the theater commander for recommendations on all matters affecting signal and communications personnel and for the coordination of these matters with G-1 before making such recommendations. He

prepares recommendations for the signal communications and Signal Corps part of the troop basis and constantly studies the troop basis in the light of changing plans of the theater. He recommends promotions, demotions, assignments, etc., of all signal communications and Signal Corps commissioned personnel assigned directly to the theater or to the theater signal communications system. He reviews, before approval, similar recommendations on all signal communications and Signal Corps personnel except in cases where final promotion or other authority is vested in or delegated to major commands.

b. The theater signal officer establishes the theater signal school. This school is used to train selected personnel already within the theater in new procedures or on equipment of types new to the theater and to continue the training of signal communications replacements arriving in the replacement depot or depots.

c. Requisitions submitted to the zone of interior for theater signal communications replacements should be referred to the theater signal officer for comment. Assignment policies to be executed by the theater replacement system so far as they affect signal communications personnel will be coordinated with the theater signal officer.

d. The theater signal officer is responsible for the continued training of all personnel and units of the theater signal communications system or other Signal Corps personnel or units directly assigned to the theater headquarters. He is also responsible for technical supervision of all signal communica-

tions training for other units and major commands and for recommendations to the theater commander of the measures to be taken to insure adequate training of signal communications and Signal Corps personnel.

39. SIGNAL COMMUNICATIONS PLANNING.

a. The success of signal communications in the theater depends upon planning far in advance.

(1) Before the theater is activated, the eventual as well as the immediate signal communications system of the theater must be envisaged. The theater signal officer must know all of the plans of the theater commander. He must obtain the best information available as to signal communications existing in the theater, indigenous materials, value of local labor for signal communications purposes, what signal communications requirements will be made by the press and other governmental agencies, what allied contacts or troops there will be, and what naval participation there will be in the theater.

(2) He must consider the possibility of using existing submarine cables and the effort involved in rehabilitating such cables. Where submarine cables are known or believed likely to exist, provision must be made early in the planning stages for securing cable ships, specialists familiar with the technique of cable operation, and the equipment necessary to rehabilitate such cable.

(3) The allies known or expected to be found in a theater must be considered and provision made for including in the troop basis communication center teams consisting of such linguists, inter-

preters, and liaison personnel and equipment as are required to effect an integrated communications system with these allies.

b. With all of this information in hand, the theater signal officer plans the signal communications system, the signal supply system, the cryptographic requirements and all other matters pertaining to signal communications which must be foreseen. He calculates and obtains approval for the troop basis, extended into the foreseeable future. He initiates supply action to cover immediate needs, estimated usage, and the build-up of the theater depot system. He also initiates action to secure the pool of project material referred to in paragraph 9. He arranges for the necessary cryptographic material and coordinates with the Department of the Army on the assignment of frequencies for the theater and for his stations in the Military Command and Administrative Network.

c. Although the basis of success is sound initial planning, there is a need for constant revision of plans and continuous planning. The initial plan is best made in coordination not only with the Chief Signal Officer and the Department of the Army but by working with the signal officers of the major commands and units which are to be in the new theater. When the theater has been established, it is essential that in revision of plans, the signal officers of the major commands and units be kept constantly apprised of the state of planning and that their plans be formulated into the overall theater signal plan. If the theater is to be adequately supported by the Department of the Army it is essen-

tial that the Department of the Army be fully informed of changes in plans in ample time to secure its approval when necessary and to permit it to bring support to the plan. The Department of the Army is kept informed of signal communications plans by the submission of signal communications projects. A project is justified by an explanation of the plan with an itemized bill of material, and constitutes a bulk requisition for the material necessary to carry out the plan. When necessary, projects are accompanied by requests for a change in the troop basis. Because the provision of the large amounts of material involved in a major project require time to effect orderly procurement, production, and shipment of the material, projects must be submitted far in advance of the date on which execution of the plan is to begin. The lead time, usually involving several months, is set by the distance of the theater from the zone of interior, the relative ease or difficulty of supply, and other factors. Projects should involve only those materials which are essential for the execution of the plan; projects which include large amounts of supplies and equipment as a reserve against unexplained contingencies indicate a lack of precise planning and poor supply technique in the theater.

40. MISCELLANEOUS. Many duties of the theater signal officer, or those which do not pertain directly to signal communications, have not been covered in this section. Among duties not covered are those related to radar which, though technically a part of signal communications, is not considered

in this publication. The organization and operation of the air messenger service in the theater is an example of the minor duties not covered. It is contemplated that a technical publication, including a comprehensive check list for planning, will be published later on the duties of the theater signal officer.

SECTION V

ARMY COMBAT FORCES SIGNAL COMMUNICATIONS

41. **GENERAL.** a. Success of the combat forces in the field requires fire, movement, and physical contact with the enemy. Control of units down to the individual squad and soldier is accomplished chiefly by signal communications. The means used in this signal communications and the manner of applying those means must be adapted to the problems created by the effort to control the fire and movement of widely dispersed forces, often in intimate contact with the enemy. For this reason, and because units may often have occasion to act independently, each combat force commander is given the necessary troops and equipment to establish, maintain and operate the signal communications essential to the performance of his unit's combat mission. The nearer the unit operates to the front line the more clearly is this principle established and the more closely is it followed. With larger units such as the corps and the army, the assignment of signal communications troops is not inflexible but is suited to the mission and is in consonance with the total number of troops available. Similarly, in larger units, the task of providing signal communications extends beyond the combat requirements of the unit

itself and embraces other signal communications required in the accomplishment of the overall mission but not necessarily germane to the combat performance of the unit itself. Army, army group, and sometimes even corps may take advantage of connection to the theater signal communications system to provide a part of the required trunk communications.

b. The division is the smallest unit to which Signal Corps troops are normally assigned, although some special purpose units, such as the Engineer Special Brigade, do have a signal company. In regiments and smaller units, the signal communications personnel belong to the arm or service of the unit (infantry, artillery, engineers, etc.). The fact that all personnel engaged in signal communications in the combat forces are not of the same arm or service demands a greater emphasis on cooperation and coordination than might otherwise be necessary. This is true also since the signal communications system of each unit must fit into that of the next larger unit so as to provide an integrated system.

c. Signal communications in the combat forces may be divided into three parts, according to purpose, as follows: (1) command and administration; (2) control of fire and movement or both; and (3) liaison with supporting forces such as the Navy or Air Force. Because of the difference in purpose, the three parts are somewhat independent of each other.

d. In the effort to combine all communications into a single integrated system on a broad concept, it is primarily the command and administrative

facilities which must be carefully integrated. On a limited concept, the other parts of combat force communications may be integrated as desired but only without diminishing their effectiveness or that of the overall integrated system.

42. SIGNAL COMMUNICATIONS FOR COMMAND AND ADMINISTRATION.

a. Each commander from army group down to battalion must have command communications to each next subordinate unit. Since the means are provided each commander for establishing, maintaining, and operating this signal communications system, it is his direct and full responsibility and, in his name, also that of his signal officer. While each such system is primarily for the use of the commander of that echelon of command, it must be designed and planned to fit into the signal communications system of the next higher commander. The responsibility for the establishment of signal communications transcends tactical areas; therefore, signal communications troops from the superior unit frequently work forward of the command posts of the next subordinate unit. It is normal for division signal officers to furnish radio teams at regimental headquarters for operation in the division command network, and wire construction teams from the division signal company are always attached to regiments for the purpose of extending the division wire system.

b. The command and administrative system generally serves command, administration and supply; this is especially true in units smaller than an army

where supply and administrative agencies are located, for the most part, near the command posts of the headquarters which they serve. This is not generally true of the supply, evacuation, and administration agencies for the army and sometimes the army group. There is required a separate signal communications system for the supply, evacuation and administration agencies in army and army group. Although this latter system operates as an integral part of the army signal communications service, it usually has to be planned and engineered as a separate project because the facilities served are not normally in the vicinity of command posts or of signal communications routes connection command posts. Types of installations served by this particular network are replacement centers, hospital areas, supply dumps, depots, repair shops and port installations, as well as the large number of brigades, groups, battalions and separate companies of the supporting and service troops of a modern field army.

c. The separate signal communications systems required for the large number of service troops will always present peculiar problems to the army signal officer as their requirements are prone to be neglected in the planning for an operation.

43. COMMUNICATIONS FOR FIRE AND MOVEMENT CONTROL. The communications channels provided in lower combat units are primarily for fire and movement control, and should be reserved for that purpose. One example of the

use of such channels is the rather elaborate, yet simple in operation, fire control system employed by the Field Artillery. Another is the Infantry Battalion Command Network. Field wire and field telephone equipment, backed up by small portable and vehicular radio equipment, provide the basis for these systems. Another type of fire and movement control circuit is the so-called "through circuit" from a higher headquarters to an observation post or other installation well forward, which is installed, maintained and operated by the headquarters requiring its use. Special circuits required for intelligence purposes also fall into this class, as do liaison circuits between supporting artillery and supported units.

44. COMMUNICATIONS FOR SUPPORT. a.

The principal support of Army combat forces is provided by the Tactical Air Command. Wire and radio-relay operational channels are normally used for processing air request missions and for the exchange of battle information and intelligence. In addition, a separate radio communications system may be provided at army, corps, and division level for insuring this support. This separate radio communications system provides for radio nets that link the Air-Ground Operations Section at the Joint Operations Center directly with corps, divisions, and ground liaison officers stationed at units of the Tactical Air Command. The Joint Operations Center is manned by Army Air Force and Navy personnel (when necessary). The functioning of the

air-ground system is described in detail in FM 31-35.

b. During amphibious operations support is given by the Navy, and support communications must be provided for both naval gunfire and naval air support. Communications plans for this must be prepared well in advance of any contemplated operation, in order that the necessary personnel and equipment can be provided at the proper places and at the proper time. Each operation must be planned separately since the number and type of circuits required will depend upon the number of naval units available for support, the number of landing beaches, etc. Since support by other forces is vital to success in any operation, it is imperative that support communications be the best obtainable. The signal officer of the combat unit must, by close liaison with the supporting units, insure that adequate signal communications are established.

45. UNIT SIGNAL OR COMMUNICATIONS OFFICERS.

a. A signal officer is assigned to each division, corps, army, army group, or task force of size commensurate to any one of them. A communications officer is assigned to each regiment or smaller unit having signal communications personnel; the communications officer is normally of the same arm or service as the unit to which he is assigned. Each signal or communications officer has duties as a staff officer and as a commander. In division and larger units he performs his duties as a commander in the manner described in para-

graph 3, to be as free as possible of the burden of administrative detail. In regiments and smaller units, he commands directly the signal communications troops assigned to the headquarters.

b. The principal duties of the signal or communications officer are—

(1) Advising the commander on all signal communications matters, including the location of command posts.

(2) Preparation of routine and combat orders relating to signal communications including signal annexes and signal operation instructions.

(3) Control of supply of signal communications equipment for signal communications units assigned or attached to his headquarters and for signal communications units of units subordinate to his headquarters. In the case of army group and corps signal officers, the signal officer is not responsible for the supply to subordinate units.

(4) Operation of signal maintenance and repair facilities (division and higher).

(5) Technical inspection of signal equipment and recommendations relative to its care and utilization.

(6) Supervision, within limits prescribed by his commander, of all signal communications operations of the command, including training, assignment, replacement, and utilization of signal and communications personnel of units.

(7) Establishment, maintenance, and operation of the signal communications systems serving his headquarters.

(8) Staff supervision of the signal communications systems of units subordinate to his headquarters.

(9) Direct responsibility for operation of the signal center at his headquarters.

(10) Signal communications security of the signal communications system serving his headquarters and of the signal communications systems of units subordinate to his headquarters.

(11) Liaison with the signal officers of higher and lower echelons of command on details of planning the signal communications systems and other technical matters.

(12) By contact with other members of the staff and the chief of staff, continuous planning for a signal communications system and signal supply to meet the requirements of his commander's plans.

46. SIGNAL SUPPLY. a. One of the most important functions of the combat force signal officer has to do with maintenance and supply. Articles of signal equipment, unlike most other equipment, and except for minor examples such as flashlights, are almost always used only by personnel engaged in communications work. The success of communications depends upon the availability and state of repair of this equipment. Signal Corps units trained in supply and repair are assigned to the army signal communications service and are responsible for supply and maintenance of equipment to all units assigned or attached to the army. Army signal depots and dumps must be pushed well forward within the combat zone to provide short

hauls for the using organizations. Divisions draw equipment and supplies from army depots and provide signal dumps within easy reach of their subordinate units. Corps signal officers usually operate a dump only for the supply of the corps troops, but may be reinforced by army units in special circumstances to provide a larger installation. Repairs to equipment which cannot be accomplished by the using unit are handled by army teams attached to divisions and corps from the Army Signal Repair Company and by the army depots.

b. Army dumps and depots are stocked by arrangement with the theater signal officer and depots, when no longer required as the army moves forward, are normally turned over with such stocks as have not been moved forward to new locations to the theater signal officer for use as advance depots if they fit into his plans.

c. The cardinal principle in signal supply is that the equipment needed must be made available as near to the place it is to be used at the time it is needed.

47. SIGNAL INSTRUCTIONS AND ORDERS.

a. Directives and instructions pertaining to signal communications in the combat forces are contained in—

- (1) Standing Signal Instructions.
 - (2) Signal Operation Instructions.
 - (3) Signal Orders (Annexes to Field Orders).
- All of them are issued in one form or another by

army groups, armies, corps and divisions for the use of their subordinate units.

b. Standing Signal Instructions contain those operating procedures and general instructions and directives that are permanent in nature. In larger headquarters it is normal to issue them as an item of the SOI.

c. Signal Operations Instructions are a form of field order issued for the technical control of all signal communication agencies throughout the command and contain such operational data and instructions as are subject to periodic or frequent change.

d. Both Standing Signal Instructions and Signal Operation Instructions are continuing publications and changes are made by merely substituting items for those to be superseded or adding new items as the occasion demands.

e. Signal Orders, conversely, are issued only for a particular operation and may be either verbal or written. If written, they may consist of either a statement in paragraph 5 of the Field Order, or they may be included in an annex to the Field Order.

f. All Signal Communications Instructions and Orders are issued in the name of the commander, and except when they are published as an annex to a Field Order are normally authenticated by the signal or communications officer of the command.

g. 24-16 contains detailed instructions for the preparation of all Signal Orders, and it is not necessary to repeat them here. However, it should be stated that the preparation of clear, concise Signal

Operation Instructions is of primary importance to the success of signal communications. The time spent in their preparation will be more than repaid as operations proceed.

48. SIGNAL COMMUNICATIONS TRAINING.

a. The training of communications personnel in all echelons of the combat forces is the direct responsibility of the signal officer of each echelon from division to army group under such restrictions as may be imposed upon him by his commander and in accordance with general training directives of the command. The signal officer makes plans for and supervises the signal communications training of the entire command. Replacement personnel (whether loss or filler) received by units receive individual and specialist training only up to the point which qualifies such personnel to begin team training. Specialist training should, therefore, continue either to improve individuals in their assigned specialty or to train well qualified individuals in additional specialties. In division, central schools or centrally controlled and coordinated schools are established for the training of signal communications specialists. It is extremely important that instruction of these specialists be coordinated and controlled under the signal officer, since efficient signal communications depends to a great extent upon the standardization of instruction in technique and procedures. Similarly, corps and army signal officers establish specialists' schools for the training of nondivisional signal communications troops.

(1) Team training is conducted concurrently with specialist training in all echelons.

(2) Training directives issued by the command always contain instructions on signal communications training prepared by the signal officer in coordination with G-3.

b. Since radio and wire telephone circuits are used by officers and enlisted men who are not signal communications personnel, continuous training must be carried on in voice radio procedure, the use of the phonetic alphabet and security regulations. Continual vigilance on the part of the signal officer is required to see that this type of training is not neglected.

49. SIGNAL COMMUNICATIONS PLANNING.

a. Planning for signal communications is a continuing process. It must be started even before the tactical plan for which the signal communications is to be provided has crystallized, and planning must always be ahead of the current situation. The signal communications officer advises his commander and other members of the staff on all matters involving signal communications and insures that timely information is available for all concerned to carry out his commander's desires. In turn, he must be kept informed of every detail of advance planning by the commander or staff which may affect signal communications.

b. It is often necessary in communications plans to go into greater detail than in other plans because of the complicated nature of communications net-

works and the fact that each integral part must work into a larger overall system.

50. STAFF COORDINATION AND COOPERATION.

a. Signal officers and communications officers confer and consult with all staff officers of the command. They must, to be successful, merit the confidence of the rest of the staff and always be willing to help them solve their difficulties. They do not wait for other staff officers to bring problems to them, but by frequent consultation search out the problems and suggest means for solving them. There is no hard and fast circuit diagram for a communications network because special facilities for a special situation are the rule rather than the exception. A signal officer must be able at all times to meet these situations cheerfully and willingly.

b. Success of signal communications depends in large part upon the careful coordination by each signal or communications officer with the signal or communications officers of the next higher and of the next lower echelons. This coordination covers details of planning, technical matters, supply, and personnel, and its effective use without transgressing the prerogatives of command is absolutely essential to success. Signal and communications officers must learn from their individual commanders what are the limits to be observed in this technical coordination with higher and lower headquarters.

c. Since the regimental headquarters level of the division is on the line of cleavage between Signal

Corps operation of the overall division communications system and its operation by other arms, the need for coordination and assistance is particularly important at this level. Division signal officers must be, at all times, conversant with the problems of regimental communications officers and anticipate their requirements in personnel and equipment.

d. There are listed below some items which must be coordinated with the staff. This should not be considered a complete list but merely a reminder that there are many others and that coordination is the keynote to a successful job:

<i>Items</i>	<i>Coordinate with—</i>
Personnel, replacements, rewards, circuits to replacement centers	G-1
Security, circuits for special intel- ligence missions, cryptographic requirements	G-2
Command circuits, current opera- tions, communication units, SOI's, Signal Orders	G-3
Location of supply installations, administrative communication for logistics	G-4
Railway and water communication facilities, port and harbor control	Transportation
Photography	All of the staff

INDEX

	<i>Paragraphs</i>	<i>Pages</i>
Adjacent units, responsibility for	4	7
Administration and command communications in combat forces	42	83
Allies, planning for in theaters of operation	39	77
Allocation of circuits:		
By Chief Signal Officer	27	51
General	7	15
In theaters of operation	34	66
Amphibious operations:		
Circuits for	44	85
Command post	5	9
Annexes, signal. (<i>See</i> Instructions.)		
Antennas	18	31
Assault wire	17	27
Assignment of—		
Personnel	11	23
Troops in combat forces	41	81
Authority, delegation of	2, 13, 37	3, 24, 74
Cable:		
Coaxial	17	27
General	17	27
Spiral four	17	27
Submarine	39	77
Can signs, responsibility for assignments..	13	24
Carrier equipment	19	36
Chief Signal Officer, responsibilities:		
General	26	50
Major commands, theaters, etc.	28	53
Military Command and Administrative Network	27	51

	<i>Paragraphs</i>	<i>Pages</i>
Personnel	31	63
Planning	32	64
Supply	29	56
Training	30	61
Circuit allocation. (<i>See</i> Allocation of circuits.)		
Combat forces signal communications	41, 50	81, 93
Command and administration communications in combat forces	42	83
Command of signal or communication troops	3	4
Command posts, location and movement..	5	9
Command, relation to signal communication	1	1
Common battery. (<i>See</i> Telephones; Switchboards.)		
Communication centers	8	17
Communication within the unit	3	4
Control of—		
Signal and communications troops ...	3	4
Signal depots, dumps, etc.	9	19
Courier service in theaters of operation ..	34	66
Critical items, control of	9, 37	19, 74
Delegation of authority. (<i>See</i> Authority.)		
Dispatch of messages	8	17
Distribution of messages within a headquarters	8	17
Duplication of messages	8	17
Duties of—		
Chief Signal Officer. (<i>See</i> Chief Signal Officer.)		
Signal officer	13	24
Electrical means, general	16	27

	<i>Paragraphs</i>	<i>Pages</i>
Facsimile	22	45
Field wire	17	27
Fire and movement control communications in combat forces	43	84
Frequencies:		
Classification and characteristics chart	18	31
Consideration of	18	31
Responsibility for assignment	13	24
Instructions, orders, and annexes in combat forces	47	89
Joint operations (<i>see also</i> Amphibious operations)	44	85
Lateral communication, responsibility for..	4	7
Local battery. (<i>See</i> Telephones; Switchboards.)		
Location and movement of command posts	5	9
Long distance systems in theaters of operation	34	66
Magneto switchboard. (<i>See</i> Switchboards.)		
Maintenance:		
General	9	19
In combat forces	46	88
Major commands, theaters, etc., responsibilities of Chief Signal Officer for. (<i>See</i> Chief Signal Officer.)		
Manual telegraphy	21	44
Message center. (<i>See</i> Communication centers.)		
Means of signal communication	14-25	25, 47
Messages:		
Authentication, preparation, distribution, etc.	8	17
Messengers (<i>see also</i> Courier service)...	15, 25	25, 47

	<i>Paragraphs</i>	<i>Pages</i>
Military Command and Administrative Network	26, 27	50, 51
Movement and location of command posts	5	9
Open wire	17	27
Orders, signal. (<i>See</i> Instructions.)		
Personnel:		
General	11	23
In theaters of operation	38	75
Responsibility of Chief Signal Officer for	31	63
Photography, responsibility of commander for	13	24
Pigeons	23	46
Pipeline, communications for	34	66
Planning:		
By Chief Signal Officer	32	64
General	12	24
In combat forces	49	92
In theaters of operation	39	77
Within unit	3	4
Pools of equipment. (<i>See</i> Supply.)		
Press, provisions for in theaters of operation	34, 39	66, 77
Principles of use of the means	25	47
Projects. (<i>See</i> Supply.)		
Radar	13, 14	24, 25
Radio (<i>see also</i> Frequencies):		
General	18, 25	31, 47
In theaters of operation	35	72
Interference	18	31
Relay system	19, 25	36, 47
Railway, communications for	34	66
Reception of messages	8	17

	<i>Paragraphs</i>	<i>Pages</i>
Relation of command and signal communication	1	1
Repeater equipment	19	36
Reserves in theaters of operation	34	66
Responsibility—		
For signal communication within subordinate units	3, 4	4, 7
Of signal and communications officers (<i>see also</i> Duties)	1	1
Runners. (<i>See</i> Messengers.)		
Schools (<i>see also</i> Training):		
General	10	21
In combat forces	48	91
In theaters of operation	38	75
Responsibility of Chief Signal Officer for	30	61
Security:		
Electrical circuits, general	25	47
General	6	11
In theaters of operation	36	73
Radio circuits	18	31
Relaxation of	6	11
Responsibility for	6	11
Telephone circuits	19	36
Teletypewriter circuits	20	41
Wire communication	17	27
Signal communication to adjacent and supported units	4	7
Signal communications:		
Personnel. (<i>See</i> Personnel.)		
Planning. (<i>See</i> Planning.)		
Training. (<i>See</i> Training.)		
Signal supply. (<i>See</i> Supply.)		
Spiral-four cable	17	27
Staff:		
Coordination and cooperation in combat forces	50	93

	<i>Paragraphs</i>	<i>Pages</i>
Relations of signal and communications officers	2	3
Subordinate units:		
Location of command posts	5	9
Responsibility for communication	3	4
Supply, signal:		
Coordination of	9	19
General	9	19
In combat forces	46	88
In theaters of operation	37	74
Pools of equipment	9, 37, 39	19, 74, 77
Projects	34, 39	74, 77
Responsibility:		
For System	9	19
Of the Chief Signal Officer	29	56
Support, communications for, in combat forces	44	85
Supported units, communication for	4	7
Switchboards	19	36
Common battery	19	36
Magneto or local battery	19	36
Tables of organization and equipment	9	19
Telephones	19, 25	36, 47
Amplifying	19	36
Common battery	19	36
Local battery	19	36
Sound-powered	19	36
Teletypewriter	20, 25	41, 47
Theater of operations, general	32	64
Theater signal:		
Communications	33, 40	66, 79
Communications service	34	66
Officer, responsibilities for radio communication	35	72
Schools. (<i>See</i> Schools.)		
Training (<i>see also</i> Schools):		
General	10	21

	<i>Paragraphs</i>	<i>Pages</i>
In combat forces	48	91
In theaters of operation	38	75
Responsibility of Chief Signal Officer	30	61
Standardization of	10	21
Troops, control of	3	4
Trunk circuits	19, 25	36, 47
Allocation of. (<i>See</i> Allocation of circuits.)		
Unit signal or communications officers in combat forces	45	86
Visual and sound communications	24	46
(War Dept.) Department of the Army Signal Communications	26, 32	50, 64
Wire (<i>see also</i> Cable)	17, 25	27, 47
Assault	17	27
Field	17	27
Open	17	27
Security of	17	27

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